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Report of the chief.

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REPORT OF THE CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY, 1939

UNITED STATES DEPARTMENT OF THE INTERIOR,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., August 31, 1939.

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

DEAR MR. SECRETARY: I present herewith the report of the Bureau of Biological Survey for the fiscal year ended June 30, 1939, the last of its series of 54 annual reports as a unit of the Department of Agriculture.[1]

Sincerely yours,

IRA N. GABRIELSON, *Chief.*

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[1] The Bureau of Biological Survey was transferred to the Department of the Interior, effective July 1, 1939 (Public Res., No. 20, 76th Cong.—approved June 7, 1939), in accordance with the President's Reorganization Plan No. II, submitted to the Congress on May 9, 1939, pursuant to the provisions of the Reorganization Act of 1939 (Public, No. 19, 76th Cong.—approved April 3, 1939). This organization was established for wildlife research in the Department of Agriculture on July 1, 1885, as the Section of Economic Ornithology, Division of Entomology; the following year it became the Division of Economic Ornithology and Mammalogy (abbreviated in 1891 to Division of Ornithology and Mammalogy); on July 1, 1896, it was designated the Division of Biological Survey, and 9 years later the Bureau of Biological Survey.

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INTRODUCTION

The work of the Bureau of Biological Survey was signalized during the fiscal year 1939 by the beginning of operations under the Pittman-Robertson Act of 1937 (50 Stat. 917), which authorizes financial aid to the States in their wildlife-restoration projects; by substantial progress in the waterfowl-restoration program, through the establishment, reconditioning, and development of national wildlife refuges and their increased value to migratory birds; and by the dedication of a national wildlife-research refuge on the Patuxent River, within a short distance of the National Capital—the first national wildlife experiment station of a general nature.

FEDERAL AID TO STATES

The Federal Aid to Wildlife Restoration Act, which became effective on July 1, 1938, authorized operating appropriations of not to exceed the annual revenue from the 10-percent tax on sporting arms and ammunition. Collections from this tax for the fiscal year 1939 have thus far totaled $2,976,019. The initial appropriation to the Bureau was $1,000,000, to be matched by about $300,000 of State funds; and for the coming fiscal year $1,500,000 has been appropriated. The act requires the States to submit full information regarding their proposed wildlife-restoration projects and, following approval by the Chief of the Biological Survey, acting for the Secretary, to complete them in an acceptable manner. The States will pay not less than 25 percent of the cost of projects that are approved and the United States not to exceed 75 percent.

At the close of the first year, 42 States had enacted the required assenting legislation, 1 had a similar bill pending, and 5 remained ineligible; 37 States had proposed approvable projects. The wide variety of well-considered plans already submitted attests the earnest desire of State conservation authorities to advance the cause of wildlife restoration effectively. The Pittman-Robertson Act has been termed one of the most beneficial measures adopted in recent years for wildlife conservation, probably the most constructive in its class since the passage of the Migratory Bird Treaty Act of 1918.

NATIONAL WILDLIFE REFUGES

The number of national wildlife refuges under the jurisdiction of the Survey reached a total of 260, with an acreage of 13,530,160, an increase of 12 refuges and of nearly 2,000,000 acres. The year saw the major engineering developments completed on many of the 1934–36 acquisition units, so that these additions to the refuge system are now for the first time fully demonstrating their value in the wildlife-restoration program. Attracted by the improved habitat provided, waterfowl and other migratory birds, as well as resident species, are visiting these sanctuaries in ever-increasing numbers, and on many units species long absent or previously unknown there are becoming established as part of the nesting population. The biological reconditioning and the engineering development of both the new and the older refuges are proceeding satisfactorily, the work being furthered by the aid of the Civilian Conservation Corps, the Works Progress Administration, and the National Youth Administration.

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PATUXENT RESEARCH REFUGE

The dedication of the Patuxent Research Refuge, Md., on June 3 by the Secretary of Agriculture is significant in its promise of future improvements in wildlife-management practices. There is now available close to the seat of the Government an extensive tract containing forests, streams, and ponds on which qualified biologists can study wildlife and its needs continuously through all seasons of the year. The research will include experiments in game and fur-animal management, manipulation of habitat, studies of the food and cover requirements and of the economic relations of resident species of the vertebrate fauna, investigations of wildlife diseases, propagation of the food plants of wildlife, and production of upland and other game birds under controlled conditions. The experiments are now in progress and will be considerably expanded when laboratories and quarters now under construction are ready for the research personnel. The wildlife investigations at the new refuge are supplemented by related research on big game and other wildlife on the Wichita Mountains Wildlife Refuge, Okla.; by research at fur-animal experiment stations and wildlife-disease research laboratories; and by investigations on waterfowl and other refuges in all parts of the country as an undertaking incidental to their main purpose, which is to provide breeding, feeding, resting, and wintering grounds for migratory birds and other kinds of wildlife.

OTHER FEATURES OF THE YEAR

Other matters of outstanding importance to the Bureau's work are briefly summarized as follows:

ORGANIZATION

Reorganization.—Pursuant to the Reorganization Act of 1939 and in accordance with the President's Reorganization Plan No. II of May 9, the Bureau of Biological Survey was transferred, effective July 1, 1939, to the Department of the Interior.[2]

Game Commission employees.—Recommendations of the Alaska Game Commission and this Bureau resulted in covering positions of Commission employees into the classified civil service.

WATERFOWL RESEARCH

Wintering grounds in Mexico.—Field investigations developed the importance to the migratory waterfowl of the Central and Pacific flyways of wintering grounds in eastern and western Mexico, which extend farther south than was formerly believed.

Breeding grounds in Canada.—Preliminary aerial surveys in northern Canada located a waterfowl-breeding ground of the first magnitude extending about 70 miles along the coast and back into a region rarely visited by white men.

Food of ducks.—The results of studies of the food habits of North American diving ducks and of the principal foods of shoal-water and diving ducks generally, including identification, range, and propagation of the various plants, were published in two technical bulletins.

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[2] See footnote 1, p. 1.

Waterfowl-disease studies.—The positive and negative relations of various types of aquatic vegetation to the production and control of botulism in waterfowl were established.

Predation on nestlings.—Predator-waterfowl relationships studied on national wildlife refuges disclosed the average nesting success to be 60 percent, with most of the losses caused, in order of depredation importance, by skunks, bull snakes, crows, magpies, coyotes, and snapping turtles.

FUR-PRODUCTION INVESTIGATIONS

Census of fur animals.—Arrangements were completed for including in the decennial census, for the first time, questions pertaining to fur-animal production.

Fur-animal reproduction.—Research on reproduction in minks and muskrats yielded important embryological information and facts of practical value, particularly in mink breeding.

Physical properties of fur.—In a study to determine the factors that contribute to the production of fur of superior quality, mounting media were found that revealed the inner structure of the fibers, and the technique, including use of photomicrographs, developed results of practical application.

Fur-animal disease control.—Large-scale vaccination on fur farms and other methods of immunization, notably against distemper, proved of protective and financial value.

OTHER WILDLIFE STUDIES

Birdbanding.—Nearly 500,000 game and other birds were banded, bringing the grand total to more than 3,250,000, from which more than 200,000 return and recovery records are now available for study.

Attwater's prairie chicken.—A comprehensive study was completed in Texas of Attwater's prairie chicken, which is threatened with the fate of its extinct, close relative, the heath-hen; the results will be published in the North American Fauna series.

Quail-nutrition research.—Cooperative studies of the nutritional requirements of bobwhite quail and the chemical and mineral composition of their important foods were begun, to provide a basis for feeding in captivity and improving native ranges.

Food of ruffed grouse.—In a published report on the early winter foods of ruffed grouse on the George Washington National Forest, the Bureau made recommendations as to forest clearings and other improvements of grouse habitat.

Dove studies.—Investigations of the breeding and other habits of white-winged doves in Arizona contributed basic information for fixing hunting-season dates and adopting other management policies.

Big-game estimates.—Data on the Bureau's big-game inventory of the United States for 1937 were collated and the results issued as a leaflet (BS–122).

Food of coyotes.—An extensive study of the food habits of coyotes revealed that more than 75 percent of their feeding is on rodents and carrion and thus economically beneficial or harmless, and about 20 percent involves the destruction of domestic stock, poultry, deer, and wild birds.

WILDLIFE RESTORATION

State restoration projects.—Of 87 Federal-aid projects submitted by 37 States, 58 (in 31 States) were approved. The 87 projects were divided as follows: Game-management research, 30; development for wildlife, 28; acquisition of refuge areas, 28; and combination research and development, 1.

Acquisition of resettlement projects.—Eight former resettlement projects, involving about 300,000 acres, were transferred to the Biological Survey for use as wildlife refuges.

State cooperation.—Virginia and Maryland enacted legislation consenting to the segregation for national sanctuaries of water areas important to migratory birds.

Reservation of bighorn ranges.—The Kofa and Cabeza Prieta Game Ranges, Ariz., aggregating 1,520,000 acres, were established in cooperation with the Grazing Service, Department of the Interior, principally for the protection of the Gaillard bighorn sheep.

Refuge revenue.—From sales of surplus big game and other products of national wildlife refuges and from fees for uses of refuge lands, $45,213.52 was deposited in the Federal treasury.

LAW ENFORCEMENT

Illegal game handling.—Provision by Congress of funds for undercover operations greatly facilitated work for preventing illegal game dealing; constant vigilance was exercised to suppress nefarious attempts to revive the use of plumage of wild birds in the millinery trade.

Court decision on baiting.—A district court ruling makes it unnecessary for the Government to aver in the information or to prove at the trial that a defendant had knowledge of the unlawful baiting of a hunting ground to render him amenable to punishment for a violation of the Federal law protecting migratory birds.

International-boundary patrol.—Joint aerial-boundary patrol by wildlife agents of the Alaska Game Commission and Provincial police officers of Canada broke up a well-organized ring engaged in smuggling wolf and coyote pelts into Alaska for collecting the $20 Territorial bounty and also resulted in the apprehension and conviction of game-law violators on both sides of the border.

PEST CONTROL

Waterchestnut suppression.—Cooperative work was begun for determining and applying methods for the control of the introduced waterchestnut, a plant that impedes river navigation and lessens the value of infested areas to waterfowl and fishes.

Predatory animals.—Further protection of domestic livestock, poultry, and game resulted from the taking of 104,076 predatory animals in cooperative campaigns.

Injurious rodents.—Under Bureau supervision 35,465,078 rodent-infested acres were treated to protect crops, range vegetation, silvicultural plantings, and irrigation and soil-conservation structures.

DISSEMINATION OF WILDLIFE INFORMATION

Continuing its function of disseminating information on its activities in wildlife research, conservation, and management, the Bureau contributed several numbers to the Department's series of new and revised publications and issued a number of brief leaflets to assist in answering correspondence.

Through the facilities of the National Broadcasting Co., during the National Farm and Home Hour, a spokesman for the Bureau discussed various wildlife problems and activities in a weekly series of radio talks, and the Bureau cooperated with the American Wildlife Institute by furnishing speakers and information for many of the weekly programs broadcast on a network of the Mutual Broadcasting System. Many other radio talks and other addresses were made by members of both the Washington and field staffs. Statements were furnished the press on the important developments in the Bureau's work, and the increasing interest of the press and writers in wildlife information was served in correspondence and interviews. An increase in requests for photographs was noted. Plans were made for motion-picture work but had not progressed far enough to make possible an adequate program.

Members of the technical staff represented the Bureau at gatherings of scientists, conservationists, stockmen, farmers, and others interested in various phases of wildlife research and management, where they had opportunity to present in detail many matters summarized in this report.

FUNDS AVAILABLE

To finance the work of the Survey for the year a total of $6,889,344 was available from regular and emergency appropriations. Of this sum, $3,063,340 was carried in the Agricultural Appropriation Act for regular activities; $1,009,008 was deposited from sales of Federal migratory-waterfowl hunting stamps; and $22,810 was allocated from the Bankhead-Jones special research fund. From the Emergency Relief Appropriation Act of 1938 there was allocated $1,321,786 for water-conservation and wildlife-restoration work and $82,500 for administrative expenses; and $1,389,900 was made available for expenditure in connection with work performed by the C. C. C. on national wildlife refuges.

ORGANIZATION

No changes in the major organization were made during the year. The officials in charge of the several divisions on the date of this report, together with the regional directors, are listed below. All 10 regions are now in full operation.

Chief of Bureau—Ira N. Gabrielson
Associate Chief—W. C. Henderson
Chiefs of divisions:
- Administration—W. R. Dillon
- Public Relations—H. P. Sheldon
- Wildlife Research—W. B. Bell
- Federal Aid in Wildlife Restoration—A. M. Day
- Land Acquisition—Rudolph Dieffenbach
- Wildlife Refuges—J. C. Salyer, II
- Construction and C. C. C. Operations—H. W. Terhune
- Game Management—W. E. Crouch
- Predator and Rodent Control—Dorr D. Green

Regional directors (with headquarters):

1. Pacific—Thomas B. Murray (acting), Portland, Oreg.
2. Mountain—Leo L. Laythe, Denver, Colo.
3. Southwestern—John C. Gatlin, Albuquerque, N. Mex.
4. West Central—George Tonkin, Des Moines, Iowa
5. Southern—Roy Moore, New Orleans, La.
6. East Central—Daniel H. Janzen, Milwaukee, Wis.
7. Southeastern—James Silver, Atlanta, Ga.
8. Northeastern—S. Barry Locke, Boston, Mass.
9. Plains—Burnie Maurek, Omaha, Nebr.
10. Alaska—Frank Dufresne, Juneau, Alaska

Under a ruling of the Civil Service Commission all positions under the Alaska Game Commission were placed in the classified civil service and the employees were given competitive status, including retirement benefits.

A directory of field activities of the Biological Survey, organized geographically and containing also a brief functional and historical account of the Bureau and a statement of the functions of each of its divisions, was issued in June as Miscellaneous Publication 343.

RESEARCH ON THE STATUS AND MANAGEMENT OF WILDLIFE

MIGRATORY WATERFOWL

INVESTIGATIONS IN CANADA

Investigations into the status of migratory waterfowl were resumed during the summer of 1938 under the leadership of the Bureau's four flyway biologists. Vast areas in Canada and Newfoundland as well as in Alaska were surveyed from both ground and air. North to the Arctic coast in every section where the conditions were favorable the investigators found evidence of further increases in ducks and geese. Nevertheless, they were unanimous in concluding that available habitat can still support greatly increased waterfowl populations.

In the Pacific flyway the investigator pressed his work northward through British Columbia, checking areas that had received attention in previous seasons. Conditions continued to be satisfactory in this Province, but little change was detected.

Because of the convergence in Canada of the Central and Mississippi flyways, they are here treated together. Although the average precipitation in Alberta and Saskatchewan was still far below normal, nesting conditions were somewhat more favorable.

In Alberta, thousands of sloughs in the district east of Calgary continued dry, but some were sufficiently filled to be satisfactory for nesting. Some water areas had a fair duck population, but the average was low, especially in numbers of birds actually raised. Beyond this zone, to about latitude 52°, most of the prairie lakes and sloughs remained dry or were so lacking in cover as to be unattractive to ducks. Farther north, however, conditions were somewhat better and indicated an increase of possibly 20 percent in the total duck population.

Drought in many localities of Saskatchewan has been continuous for so many years that relatively little general improvement could be expected. The pot-hole sectors in the southern part remained dry or otherwise unattractive to ducks. Of the 15 Provincial bird sanctuaries that were dry in 1937, 6 remained so in 1938, as did also 9

of the 13 public shooting grounds. Of the lakes that 10 or more years ago provided excellent waterfowl nesting conditions, scores were still dry. Reports from sections about Prince Albert indicated that pot holes were even drier than in 1937 and that fewer ducks nested there. Nevertheless, field studies indicated a slight improvement.

Fires in certain large marshes, particularly in Manitoba, continued to be serious problems, as they destroy valuable food and cover and also nests and the birds themselves. On one section of 10,400 acres south of the town of Delta, which had been swept by a fire that spread over an area estimated to be fully 10 times as large, 1,300 destroyed duck nests were counted, averaging 8 eggs each. In the southern part of this Province, however, particularly in the marshes at the south end of Lake Manitoba, a marked improvement in waterfowl conditions was noted, with a decided increase in the number of redheads and canvasbacks and some increase also in shovelers. The biologists felt, however, that in the Prairie Provinces in general there was cause for optimism regarding the duck situation. They found that broods averaged larger and estimated that nesting birds showed an increase of about 10 percent over 1937.

The 2,500 square miles of duck-nesting habitat in the great marshes of the Athabaska delta also showed improved production. The biologist of the Mississippi flyway made his fourth consecutive annual trip to this important nesting ground and reported that, despite low water levels, the waterfowl were considerably more abundant than last year or any year since 1935.

Proceeding by plane, the biologist resumed investigations in another important waterfowl area of the North—the lower Mackenzie delta. The study there indicated that while ducks were somewhat less numerous than in 1937, their numbers were satisfactory. Any possible reduction in the duck supply was compensated for by an excellent increase in the number of swans, geese, and black brants.

About the middle of July the biologist flew from Aklavik, in the Mackenzie delta, via Fort Norman, on Great Bear Lake, to Coppermine, on Coronation Gulf, and thence reached the easternmost point of his journey in the Arctic at Cambridge Bay, on the southeastern coast of Queen Victoria Island. From this point on the night of July 18 he attempted to fly to Perry River in the Flagstaff Island group, about which practically no information is available. He was successful in locating the river but could not land because of ice conditions. From his aerial survey, however, he reported that as a waterfowl habitat the Perry River country had all the appearance of a second Mackenzie delta. Between it and the Ellice River, a distance of about 70 miles, the many streams emptying into the Queen Maude Sea and the numerous lakes probably make this section a waterfowl nursery second to few in the Arctic. The place is so nearly inaccessible that few white men have ever visited it, and the Survey biologist and his pilot are probably the first to have seen it from the air.

The biologist for the Atlantic flyway, entering Canada on May 11, made extensive investigations through the first half of July in New Brunswick and Nova Scotia, and in Quebec along the north shore of the Gulf of St. Lawrence. He stated that from the excellent conditions observed and reported by others in New Brunswick there

would be a good increase of wild fowl during the season, particularly over the 1937 numbers of Canada geese and black ducks. In Nova Scotia, investigations in the vicinity of Wolfville and in every important waterfowl area also indicated a slight increase over the 1937 numbers of black ducks. The coast of Canadian Labrador, in southern Quebec, was covered for a distance of nearly 600 miles from Bradore Bay west to Mingan, where the Canadian Government has several migratory-bird sanctuaries, all of which were visited. Later in the season Quebec was again entered by way of St. Simeon, and observations were made north into the interior to Lake St. John, Mont Laurier, and Rouyn. At this period reconnaissance was made also in Ontario north as far as Cochrane and west to Sault Ste. Marie.

The Atlantic flyway biologist spent the period July 19 to August 3 in Newfoundland, most of the southern coast of which he was enabled to cover through the cooperation of the Department of Natural Resources. All the information obtained pointed to a successful season, with increased waterfowl production over that of 1937.

INVESTIGATIONS IN ALASKA

On completion of the survey in British Columbia, the biologist of the Pacific flyway proceeded to Alaska, where with the active cooperation of the Alaska Game Commission he made a reconnaissance of the chief waterfowl-breeding grounds. Beginning at Fort Yukon, on the Porcupine and Black Rivers, he made the long trip down the Yukon and in its vast delta explored many of the channels and adjoining tundra areas. After a flight across the height of land and similar investigations of the intricate maze of channels and muskegs of the Kuskokwim River, he wrote: "It is beyond the scope of imagination for the average resident of the South to visualize even remotely the extent of the northern nesting grounds." Natural food plants were abundant, and it seemed probable that Alaska produces a much larger percentage of the continental supply of wild fowl than has formerly been believed. Reports of Alaskans indicated a steady improvement in the supply of ducks, but not a comparable increase of geese. There was abundant evidence, however that the available waterfowl habitat in Alaska is woefully underpopulated.

INVESTIGATIONS IN MEXICO

In western Mexico, the biologist of the Pacific flyway continued investigations from the latter part of November to the first of March. Work was done in 15 States, 1 Territory, and the Federal District, with the full cooperation and assistance of Mexican officials, particularly those of the Department of Forests, Game, and Fish, and of American consular and diplomatic officers.

Further evidence was obtained of the importance of the Mexican wintering grounds to the waterfowl of the Pacific flyway. One of the most important waterfowl concentration points was found in the great irrigation projects in the valleys of the Yaqui and Mayo Rivers, Sonora. Here probably 300,000 acres are under canal systems

for growing wheat, rice, and garbanzo (chickpea), and the fields are a very important source of food for wild fowl.

Sinaloa has a like situation in the valleys of the Fuerte, Sinaloa, and Culiacan Rivers, and from the seaport town of Mazatlan to the valley of the Rio Grande de Santiago, Nayarit, a distance of fully 100 air miles across parts of both States, there is a continuous chain of coastal estuaries, sluggish rivers, lakes, marshes, and swamps.

Conditions are similar in Nayarit, and, because of the famed Lake Chapala, in Jalisco and Michoacan also. Here the delta of the Lerma and Duero Rivers has been partly drained, but the area still remains one of the greatest concentration places for ducks, as also do Patzcuaro, Cuitzeo, and other important lakes of Michoacan. In all the smaller States visited, the Survey biologist found abundant waterfowl habitat, and on the Laguna de Coyuca and Laguna de Tres Palos, in Guerrero, a veritable paradise for wintering lesser scaups, pintails, baldpates, and other ducks.

In concluding his report, which treats of each State and species, the Bureau investigator asserted that the duck and goose population of western Mexico showed marked improvement in numbers over that of preceding years.

On the east (Gulf) coast, the Central flyway biologist divided his time between the wintering grounds of the Laguna Madre section of southern Texas and the coastal parts of eastern Mexico, making an aerial reconnaissance from the Rio Grande to the northeastern tip of the Yucatan Peninsula and carrying on ground work by car along the coast of Tamaulipas and northeastern Vera Cruz.

The marsh and water areas in eastern Mexico bear almost the same relation to the birds of the Central flyway as do those of western Mexico to the waterfowl of the Pacific flyway. The more important of these wintering grounds are the coastal lagoons of Tamaulipas, the Tamiahua Lagoon and Alvarado district of Vera Cruz, the coastal lagoons and marshes in northeastern Tabasco, and the narrow coastal lagoons and marshes of Yucatan.

An aerial survey of the coastal districts in 1937 gave a basis for comparison with data obtained in 1938. Flights were extremely low, so that great accuracy was possible not only in identifications but also in estimations of numbers. The investigator reported satisfactory evidence of a definite increase in some species. Although he received local reports of greater increases, he believed that the general increase was possibly 10 percent over the winter population of 1937–38 and that there were at least 5,000,000 ducks in the eastern coastal lagoons and marshes.

Information obtained by these biologists indicates that the total take of waterfowl by Mexicans is so low as to be almost negligible. The extent of legal market hunting there has been and still is grossly exaggerated. At a few places along the routes followed by tourists, ducks are sold in markets and served in restaurants. Those familiar with cities immediately south of the international border naturally infer that the serving of game dinners is general, whereas it is done chiefly near the border to attract tourists. There are very few cities in Mexico where game is marketed to any considerable extent. Vigorous efforts are being made by the Mexican game authorities to enforce the game law prohibiting the use of "armadas" (batteries of

shotgun barrels fastened together and fired simultaneously), and troops of the regular army have even been employed for this purpose.

INVESTIGATIONS IN THE UNITED STATES

Spring and fall migrations were again observed by the Bureau's corps of carefully selected agents and volunteer cooperators in the United States. Analysis of the figures obtained confirmed the reports made by the field biologists that the numerical status of most species was continuing to improve. The increases reported for the redheads and canvasbacks were particularly gratifying, fully vindicating the regulatory action taken for their protection.

On the national wildlife refuges and most other areas, the results of the breeding season of 1938 were a great success and reports of increases were unanimous. Improvement factors consisted not only of curtailment of the kill in recent years but also of greater stabilization of water levels, better nesting habitats resulting from planting programs and restrictions on grazing, selective control of natural enemies, and more adequate protection of breeding stock along migration routes and on wintering grounds.

The biologists of the Mississippi and Atlantic flyways devoted the winter to constant checking and rechecking concentrations at the southern ends of these two great areas, which, unlike those of the Pacific and Central flyways, are chiefly in the United States. For this reason Federal refuges in the lower Mississippi Valley and on the South Atlantic and Gulf coasts are of great importance. In the wintering grounds of the Atlantic flyway, waterfowl conditions remained satisfactory and an increase in most species was obvious.

The general improvement affected practically all species of ducks. Although the blue goose is abundant in winter on the Louisiana coast, there was an apparent shortage of immature birds. The situation for this species had been noted earlier in the season by Canadian officials on the basis of reports from the James Bay region and appears to indicate an unsuccessful breeding season.

The fifth annual inventory of migratory waterfowl was made in January, under the leadership of the 10 regional directors. Full cooperation was extended by the Army Air Corps, the Naval Air Service, Coast Guard, Forest Service, Soil Conservation Service, National Park Service, State forestry, game, and fish departments, a commercial rubber company, and many other agencies and individuals, and in addition practically the entire field force of the Survey was drafted.

The aerial coverage included the entire Atlantic and Gulf coasts. In region 7 (Southeastern), 11 planes and 3 blimps were used in addition to 18 powerboats and 28 cars, with a total of 240 observers. In region 8 (Northeastern) in addition to planes of the Coast Guard, 2 blimps from the Naval Air Station at Lakehurst, N. J., were employed. In a few areas severe storms complicated the operations and undoubtedly resulted in the tabulation of smaller numbers of birds than would have been observed a short time previously. In most cases, however, familiarity with the situation enabled the agents to make proper allowances, and sudden decreases in one area were usually compensated for by corresponding increases in others. Experience in the work has contributed greatly to the accuracy of the results, so that while cover-

age of the entire country is still incomplete, it is felt that the data assembled are dependable for comparative purposes.

The grand total in waterfowl for all regions for the 1939 inventory was about 14,500,000, which represents an increase of about 14 percent over 1938. The ratios between figures for all species are not the same—for a few a decrease was noted. Important gains were noted in some of the principal game species—the redhead, mallard, black duck, pintail, baldpate, and the scaups. Particularly encouraging is the substantial gain in the numerical status of the redhead. The increase for the scaups is somewhat surprising in view of reports obtained earlier in the season. Geese showed an aggregate decrease, a small increase in the Canada goose being offset by a decrease in the blue goose, probably because of a poor breeding season. The coot, or mud hen, showed a disproportionate increase, and there is evidence that this bird is too abundant for the welfare of other waterfowl more desirable to man.

Results of investigations of the waterfowl situation in the United States for 1938–39 were reported in a leaflet (BS–136) issued in May.

BANDING GAME AND OTHER BIRDS

WORK ON FEDERAL REFUGES

Inasmuch as the use of bait and live decoys in hunting ducks and geese has been outlawed during recent years by Federal regulations, waterfowl were banded chiefly by the regular personnel on Federal and State refuges. Stations in operation on 48 Federal refuges and on 15 State refuges, game farms, and sanctuaries reported the banding of 36,826 birds, almost entirely migratory waterfowl. The figures for Federal refuge stations where the total bandings for the year totaled 1,000 or more are as follows:

Refuge	*Number*	*Refuge*	*Number*
Sand Lake, S. Dak	7,705	Tule Lake and Clear Lake, Calif.;	
Malheur, Oreg	7,022	Klamath Lake, Oreg	1,606
Des Lacs, N. Dak	4,988	Lacreek, S. Dak	1,342
Sacramento, Calif	2,338	Medicine Lake, Mont	1,211
Piedmont, Ga	2,117	Bear River, Utah	1,136
Lake Mattamuskeet, N. C	2,007	Waubay, S. Dak	1,024
		White River, Ark	1,003

Stations are planned for other refuges favorably situated on the different flyways, and those already established will expand their work.

BIRDBANDING COOPERATORS

Physical limitations in the handling of the great mass of bird-banding records continue to make it necessary to decline many offers of cooperation. There were on the list at the end of the year, however, 2,290 cooperators as compared with 2,193 a year ago. Four of the volunteer station operators each reported the banding of more than 10,000 birds, as follows: E. A. McIlhenny, Avery Island, La., 28,845; O. L. Austin, North Eastham, Cape Cod, Mass., 19,846; John B. Calhoun, Nashville, Tenn., 16,532; and George H. Lowery, Jr., Baton Rouge, La., 11,499.

NEW BIRDS BANDED

The number of new birds reported banded was 436,648, an increase of 90,592 over 1938. This brings the grand total banded since this work was taken over by the Survey in 1920 to 3,284,142. For each of the following species 10,000 or more individuals were banded: Chimney swift, 71,623; junco, 22,274; purple finch, 21,595; white-throated sparrow, 20,495; pintail, 19,160; common tern, 17,179; herring gull, 17,168; mallard, 16,732; and black duck, 10,207. Bandings exceeded 1,000 for each of 55 other species, 8 of which were migratory game birds, as follows: Baldpate, 1,449; green-winged teal, 1,721; blue-winged teal, 4,118; lesser scaup duck, 5,290; ring-necked duck, 1,953; Canada goose, 1,187; coot, 2,401; and mourning dove, 5,539.

The following nine species were new to the list of banded birds: Bridled tern, love tern, allied shearwater, Christmas Island shearwater, and red-tailed tropicbird (all from Hawaii), and the yellow-billed tropicbird, glossy ibis, ivory-billed woodpecker, and black rosy finch.

The numbers of the different species of waterfowl banded during the fiscal years 1938 and 1939 are shown in table 1.

TABLE 1.—*Waterfowl banded during the fiscal years 1938 and 1939*

Species	1938	1939	Species	1938	1939
	Number	*Number*		*Number*	*Number*
American merganser	6	32	Canvasback:		
Red-breasted merganser	15	1	Wild	644	410
Hooded merganser	9	14	Hand-reared	96	77
Mallard:			Greater scaup	165	914
Wild	11,519	15,751	Lesser scaup	5,295	5,290
Hand-reared	2,068	981	Ring-necked duck	2,057	1,953
Black, cross	8	20	American goldeneye	3	10
Black duck:			Barrow's goldeneye		1
Wild	6,319	8,653	Bufflehead	29	18
Hand-reared	1,029	1,554	Old squaw	7	
Florida duck	159	86	American elder	4	4
Gadwall:			American scoter	2	
Wild	694	773	White-winged scoter	4	23
Hand-reared		8	Surf scoter	1	
European wigeon	5		Ruddy duck	83	41
Baldpate	1,379	1,449	Snow goose	34	4
Green-winged teal	8,372	1,721	Blue goose	280	16
Blue-winged teal	5,353	4,118	Ross' goose	3	
Cinnamon teal	420	379	White-fronted goose	39	8
Shoveler	495	582	Canada goose:		
Pintail:			Wild	458	1,163
Wild	16,060	18,861	Hand-reared	15	24
Hand-reared	300	299	Black brant	9	
Wood duck:			Emperor goose		1
Wild	405	414	Fulvous tree duck	15	1
Hand-reared	188		Whistling swan	5	7
Redhead:					
Wild	2,083	574	Total	66,234	66,290
Hand-reared	100	55			

RETURN AND RECOVERY RECORDS

The number of banded birds recaptured during the fiscal year, either at the station of banding or elsewhere, was 26,998, an increase of 4,048 over the preceding year. This brings the number of recovery records to 202,913, which is the largest collection in existence of precise information relative to the movements of individual birds.

During the open shooting season for migratory birds letters reporting returns averaged about 100 a day, with a peak total of nearly 250. Through the assistance of the Works Progress Administration several thousand records that had accumulated in past years were coded, carded, and verified. Outstanding return records were published in the quarterly journal Bird-Banding, and the annual number of Bird Banding Notes was issued in September.

Several thousand herring gulls at key breeding colonies on the Atlantic coast were marked with different colored celluloid bands in addition to the numbered aluminum bands. The large numbers of "sight recoveries" reported therefrom are being analyzed in cooperation with the Linnaean Society of New York.

RECORDS OF DISTRIBUTION AND MIGRATION

Data added to the files on the distribution and migration of North American birds continue to increase the value of this repository. The acquisitions included 50,000 distribution and migration records, 1,500 locality cards, and 900 bibliographic entries.

General migration observers now reporting total 375, and many of them have long periods of service. A digest of their spring (1938) migration data was issued as Bird Migration Memorandum No. 4, on June 15.

At the request of a private publisher a manuscript was prepared for a book, which appeared in June, under the title "The Migration of American Birds." It is an expansion of the Bureau's Circular 363, The Migration of North American Birds, and is illustrated by 22 maps and 12 color plates. In a volume entitled "Life Histories of North American Woodpeckers," issued as Bulletin 174 of the United States National Museum, data on the distribution and migration for each species were prepared by the Biological Survey; similar data were supplied on parrots, cuckoos, trogons, kingfishers, goatsuckers, hummingbirds, and swifts, the life histories of which will be published by the Museum during the coming year.

In the work of drafting distribution maps of North American birds, valuable aid was rendered by the W. P. A. in bringing to date 107 maps, covering the shorebirds, ducks, and geese, and in making new maps for 83 species, including the families of swifts, hummingbirds, flycatchers, crows, jays, and some of the sparrows and finches.

WILDLIFE RELATIONSHIPS TO FOREST AND RANGE

Two manuscripts on the relationships of wildlife to forest trees were completed, based on research at the Northeastern Forest Experiment Station, Conn. A study of the effects of the 1938 hurricane in New Hampshire indicated that the long-time results will probably be more beneficial than detrimental to wildlife. A game-food-shrub interplanting study on coniferous plantations was initiated at the Chenango Experimental Forest, N. Y., where 5,000 red-osier dogwoods were set out in experimental clump patterns to determine the best spacing. Survival and rodent-damage tallies will be kept.

Investigations of the overpopulations of white-tailed deer in Minnesota were continued at the Lake States Forest Experiment Station,

Minn., with special emphasis on the effect of overbrowsing on choice deer foods; some of the results were set forth in a leaflet (BS–137) entitled "Fall and Winter Food Habits of Deer in Northeastern Minnesota." Investigations of aspen utilization by beavers were continued, and trapping and marking studies were conducted to correlate food usage with animal abundance.

At the Southern Forest Experiment Station, La., the effect of birds and rodents on longleaf pine reproduction received primary attention. Birds consume a great deal of the annual seed fall, but the damage can be controlled. A mimeographed leaflet entitled "The Relation of Birds to the Establishment of Longleaf Pine Seedlings in Southern Mississippi" was issued as Occasional Paper 75 of the experiment station. Experimental plots were established on the Harrison Experimental Forest, Miss., at intervals of about 1 month late in fall and early in winter, to determine what effects ground cover and sowing seed at different seasons have on bird depredation and on the survival and germination of seed.

A 7-year study of pocket gopher relationship to mountain-meadow range at the Pacific Northwest Forest Experiment Station, Oreg., indicates that normal populations of these rodents and moderate grazing by livestock allow these ranges to remain stable; overgrazing causes competitive demands upon forage, making rodent activities more apparent; nongrazing permits accumulation of surface litter favorable for heavy populations of meadow mice, which deplete range plants through crown injury. As many as 35 white-footed mice to the acre have been found during the period that ungerminated Douglas fir seed remains on the ground. Shrews, previously considered noninjurious to the seeds, were found to be important in their destruction. Cropping of young conifers in this region was done mainly by rabbits. Studies show that mountain beavers are of minor importance in coniferous forests. A report on wildlife in relation to reforestation in the Douglas fir region of Oregon and Washington was completed.

Studies of wildlife in relation to western range were continued at San Joaquin Experimental Range, Calif., in cooperation with the Forest Service and the University of California. They included the effect of rodents on the composition of the plant community and the annual yield of forage, the life history and food habits of each species of rodent, population fluctuations, means of marking various species of small mammals for individual identification, and predation. A deer-management study developed from a study of the coyote-deer relationships on the Los Padres National Forest. Some 7,000 coyote droppings analyzed showed more than 160 different food items, with deer the most important, fruit second, and rodents well down the list; and the contents of 200 coyote stomachs examined revealed similar food data. That coyotes are levying heavy toll on fawns and first-year deer in these southern California brush areas is indicated not only by the hair, bones, and fawn hoofs found in the droppings, but also by the greater survival of fawns on trapped areas. During the year two leaflets were issued entitled "Factors in Nesting Losses of the California Valley Quail" (BS–124) and "Some California Wildlife-Forest Relationships" (BS–132).

BIOLOGICAL RESEARCH ON WILDLIFE REFUGES

Aerial photographs of the Wichita Mountains Refuge, Okla., were obtained from the Army Air Corps for use as a base map for plotting vegetative types. A survey of forage conditions to determine improvement resulting from the first year of elimination of permitted livestock disclosed an increase in the volume of forage but not of the more palatable plants. The wild turkey study was continued, and a census covering 5 months showed 487 on the refuge in February.

Progress was made in the development of the Patuxent Research Refuge, Md., as an investigative center. The main laboratory built last year was equipped and is occupied by several workers. Construction completed included a wildlife-disease laboratory, greenhouse, apartment house, two residences for officials, and garages and other buildings. The old mansion, Snowden Hall, was reconditioned for use as refuge headquarters, 16 acres were graded and landscaped, and the 60-acre artificial Cash Lake was filled with water. The refuge, which is adjacent to the Agricultural Research Center, at Beltsville, was officially dedicated by Secretary Wallace on June 3.

Extensive study was devoted toward improving the Bull Island unit of the Cape Romain Refuge, S. C., particularly as a sanctuary for the eastern wild turkey, now rapidly nearing extirpation. A detailed study of this bird is being made throughout the Southeastern States, especially in the Santee, Great Pee Dee, and Savannah River sections of South Carolina and Georgia, with a view to its preservation and restoration.

WILDLIFE-MANAGEMENT RESEARCH

COOPERATIVE RESEARCH UNITS

On the 10 wildlife-research units, which function in cooperation with land-grant colleges, State game commissions, and the American Wildlife Institute, the programs included basic research into wildlife-management problems, training of advanced students and research workers, testing proposed methods in trial areas, and recommending and demonstrating improved management practices. Extension is being carried on at most of the units. A total of 190 workers were engaged for whole or part time, as follows: Alabama, 18; Iowa, 26; Maine, 17; Missouri, 22; Ohio, 29; Oregon, 17; Pennsylvania, 12; Texas, 16; Utah, 14; Virginia, 19. A leaflet (BS-129), Cooperative Wildlife-management Research, was issued in March.

Alabama.—The research unit at the Alabama Polytechnic Institute conducted six projects on the life history and management of important game species. Data were obtained on breeding, nesting, growth rate, plumage change, food habits, and migration of the mourning dove. Some of the findings were presented in a leaflet (BS-133), entitled "A Preliminary Investigation of the Food Habits of the Mourning Dove in Alabama." In the bobwhite studies, operations centered on the adaptation of quail-management practices to farming conditions in the major soil provinces, including the establishment of an 1,800-acre trial-demonstration area on privately owned land. A mimeographed leaflet, Planting Food Crops for Game Birds, was issued by the Agricultural Experiment Station of the Alabama

Polytechnic Institute, and a bulletin, Winter Foods of Bobwhite Quail in the Black Belt Soil Provinces of Alabama, was published by the Alabama Department of Conservation. Other studies were concerned with white-tailed deer, wild turkeys, and the food of foxes and waterfowl at the Gulf Shores State Park.

Iowa.—Two experimental areas were established in southern Iowa by the Iowa research unit, at the State college, to test methods of quail management. On one, the farmers were encouraged to adopt game management and the sale of hunting rights as a means of increasing their income; on the other, they were paid 10 cents an acre for practicing game management and encouraged to permit free shooting. At the end of 2 years a survey indicated that the bulk of the management, which was about the same on both areas, had been done by farmers who were themselves sportsmen, irrespective of fees. An area was set aside in Winnebago County for investigation of the ring-necked pheasant, especially its winter survival. It was learned that near their source of food the birds need cover so tall that it will not drift full of snow. During periods of high wind and severe cold it proved advisable to make food available within the cover itself. Other studies were on the ecology of the muskrat, distribution and ecology of plants in waterfowl breeding areas, analysis of range carrying capacity for the bobwhite in winter, life history and management of striped and spotted skunks, ecology of mourning doves, ecology and management of the raccoon, American coot, red fox, and western fox squirrel, and parasites and diseases of the rabbit, quail, pheasant, and wild ducks.

Maine.—Woodcock-management studies continued to be one of the chief lines of research at the Maine research unit at the State university. Questionnaires sent to hunters and wardens showed that the status of the woodcock had improved slightly, and a singing-ground count of breeding pairs showed a 2-percent increase over the previous year. A cedar-reproduction plot was established with 100 trees, 50 of which were topped and 50 left natural to determine whether topping tends to increase the length of limbs, thus making more browse available for deer. Research on fish-eating birds continued. No evidence was obtained connecting the tapeworm of gulls with that found in bass. Other investigations involved waterfowl surveys of Penobscot County and the Lincoln area, life history and management of the raccoon, life history and diseases of the moose, deer weights and measurements, and snowshoe hare reproduction.

Missouri.—Investigations on the life history, ecology, and management of the wild turkey in Missouri in cooperation with the Forest Service still rank as an important project at the Missouri research unit at the State university. Although turkeys have not greatly increased during the past 3 years, predation seems to be of little consequence to the adult birds. Limiting factors operate during the nesting and brooding periods, as during the current season not more than 50 percent of the hens hatched a clutch of eggs. A study of the chukar partridge disclosed that of 104 birds found dead in the wild, 87 percent died within 2 months after release and that in the summer of 1938, 46 nesting pairs produced an average of 9.3 young each. Other investigations by the Missouri unit included a preliminary study

of the southern woodchuck, a survey of the distribution and economic importance of Missouri hawks, management of field borders in relation to agriculture and wildlife production, ecology and management of the white-tailed deer, bounty statistics on wolves, coyotes, and bobcats, ecology and management of the bobwhite and prairie chicken, wildlife-cover mapping, and ecology of song-bird communities.

Ohio.—At the Ohio research unit, at Ohio State University, special attention was devoted to pheasant management, a complete analysis having been made of the strength or weakness of each factor and the cause of success or failure of each in controlled hunting, especially in northwestern Ohio and Wood County. A census and tabulation of the hunting experiences each year of 1,000 local, city, and farmer hunters is maintained. Analysis is being made of all agricultural and land-use factors affecting pheasant production. An investigation of the life history and management of the fox squirrel was continued, with special attention to the development of research and management techniques. Work was also done on the gray squirrel, and a leaflet (BS–134) entitled "A Summary of the Gray Squirrel Investigation of Southeastern Ohio," was issued. Research on the raccoon included studies in the wild on ecology, habitats, and populations, and in captivity on diseases, nutrition, and life history. Other studies were made on foods, populations, and diseases of cottontail rabbits; population trends, cycles, and land-use factors affecting Hungarian partridges; and the status of waterfowl at Pymatuning Lake and in Lake Erie marshes. Preparation of a manual of Ohio wildlife resources was advanced.

Oregon.—Studies of small game in the Willamette Valley by the research unit at the Oregon State College resulted in action by the State Game Commission stressing quality birds on game farms, reliance on natural reproduction to carry the shooting load, liberation of birds on a scientific basis, and adjustment of open seasons and bag limits. A study of the life history and management of antelopes resulted in a controlled hunting season on a cropping-plan basis. It showed the need for limitations, as the kill was 72 percent efficient over three shooting areas and 85 percent on one. Among other problems investigated were wildlife and range management, management of the sage-hen, and game management on farm lands in the Willamette Valley.

Pennsylvania.—The recently established research unit at Pennsylvania State College has outlined an extensive program. In one of the major long-time projects, an economic and ecological survey of Pennsylvania wildlife, work was carried forward on upland birds, especially the pheasant, bobwhite, ruffed grouse, and woodcock. A census technique for white-tailed deer in Pennsylvania is being developed. The chief accomplishment of the project on the ecology, life history, and management of the black bear was the collection of specimens illustrating food habits. Ecological relationships between cottontails and woodchucks were covered in part by studies of the nesting of cottontails, population densities of cottontails and woodchucks, use of woodchuck dens by cottontails, and the distribution of woodchucks. Other projects are concerned with the nutritive value of winter deer browse and mast, silvicultural practices affecting deer foods, propagation and nutrition of game birds, and wood-lot management.

Texas.—A comprehensive study of Attwater's prairie chicken was completed by the Texas research unit at the agricultural and mechanical college. Noteworthy also are county surveys carried forward in 4 counties—Colorado (east Texas timber type and gulf prairie), Harris (gulf prairie), La Salle (Rio Grande plain, "brush country"), and Culberson (Trans-Pecos mountain and valley)—of the geology, soils, vegetation, and vertebrate animal life, to serve as the basis for wildlife-management plans in the regions of which these counties are typical. Improvements are being made in the establishment of headquarter areas for bobwhite quail. From 1936 through 1938 several hundred such areas were established in overgrazed parts of 6 counties, and a recent check of 81 of them showed bobwhite quail on 70 percent, many of them in areas not previously occupied by coveys in winter. Work was also done on the armadillo, white-necked raven, Texas bighorn sheep, Texas beaver, and several other near-vanishing species. A recently completed study of the relationship of the stage of cut-over timberlands to bobwhite production forms a basis for effective management on the 12,000,000 acres of this type in the eastern part of the State.

Utah.—The mule deer, most important big-game species of Utah, continued to be the subject of a detailed life-history and management study by the Utah research unit at the Utah State Agricultural College. On the Cache National Forest, 220 adult deer were trapped, tagged, and released. Emphasis was placed on determination of winter conditions, migrations, winter losses, and methods and economics of supplemental winter feeding. With a view to preventing a recurrence of severe losses, detailed investigations were made of winter mortality on the Cache study area, where 539 deer were found dead. Observations have been made for 3 years on the sharp-tailed grouse, particularly on its life history and on factors influencing its distribution and abundance. Distribution in the intermountain region is correlated with the presence of unmodified remnants of original grassland. In a study of sage grouse, 142 nests in 1938 and 122 in 1939 were located and kept under observation, and in a predation study the coyote proved the most important enemy. On the beaver project a field party made a detailed survey of 144 miles of streams in and near the Wasatch National Forest, in which 77 stations were established for chemical study of water on various drainages and an inventory was made of organisms inhabiting streams and ponds. All streams surveyed contained trout, and no physical or chemical conditions adverse to their welfare were found. A State survey was also made of waterfowl marshes to determine available food and nesting cover.

Virginia.—At the research unit at the Virginia Polytechnic Institute, the wild turkey still maintains a leading interest. The captive hens stopped laying in 1938 by the middle of July, having produced approximately 27 eggs each, a total of 1,600. Only 64 percent were fertile, and only 34 percent of these hatched. In spite of a heavy loss of brood stock in 1939, more than 80 percent of the fertile eggs hatched, and a total of 740 poults were alive on June 30. Distribution and factors influencing abundance of wild turkeys in Virginia are being investigated through a cooperative arrangement with the University of Michigan, and it has been learned that the species is present in 74 of Virginia's 100 counties, that the highest population

occurs in the central or piedmont section, that there were over 22,000 wild turkeys in the State prior to the hunting season beginning November 15, that at the beginning of that hunting season the State-wide average was about 11 turkeys to the flock, and that from the rather meager 1938 data the legal kill may often exceed 50 percent of the turkey population in some sections. Deer-management studies have continued, and 211 animals were obtained for release, 18 of which were tagged and liberated on the Mountain Lake demonstration area. A paper was completed on a preliminary list of the mammals of Virginia, with a view to publication by one of the cooperating agencies. Studies were continued on farm game, more especially on the bobwhite, and progress was made on a vegetational survey.

BIOLOGICAL SURVEYS AND FAUNAL RESEARCH

Reports are in preparation on the mammals of Arizona and of Florida; the manuscript on a taxonomic revision of the red squirrels will be completed during the coming year if sufficient specimens from certain critical localities can be obtained; work on a taxonomic revision of the raccoons is nearing completion; and an extensive research on the history, habits, ecology, classification, and distribution of the North American wolves is progressing. An 834-page illustrated book on the Bird Life of Louisiana was published by the Louisiana Department of Conservation, in cooperation with the Biological Survey, and progress was made on the manuscript on the birds of Texas. Related publications issued include an article in the 1938 Yearbook of Agriculture entitled "The Problem: Drained Areas and Wildlife Habitats," and Circular 520, "Wildlife of the Atlantic Coast Salt Marshes."

Additions to the research collections of mammals, birds, and other vertebrates, which continue to serve as a basis for the work of the Bureau, included 1,183 specimens of mammals and 1,334 of birds. Identifications of 678 mammal specimens were made for 25 institutions and individuals in 17 States and 1 foreign country, 195 specimens were borrowed for study from 5 institutions and individuals in 4 States and 1 foreign country, and 369 specimens were lent to 13 cooperators in 11 States and 2 foreign countries. Bird specimens numbering 4,277 were identified for 50 institutions and individuals in 25 States and 2 foreign countries, and 492 were lent to 14 institutions and individuals.

Scientists of the Bureau described 41 new mammals in the genera *Hodomys*, *Microtus*, *Perognathus*, *Urocyon*, *Thomomys*, *Platygeomys*, *Pappogeomys*, and *Heterogeomys*. The total number of type specimens of mammals in the collection is now 1,292. The Bureau's mammal laboratory was used by 110 outside research workers from 22 States and 4 foreign countries. Continuation of the W. P. A. projects expedited the work of cleaning, repairing, and rearranging the mammal collection and cataloging and assembling data on birds.

A survey of big-game mammals in 1937 was completed through cooperation of Federal and State agencies, and the collated results were issued in January in a leaflet (BS–122). Work was in progress for a similar inventory for the year 1938.

ECONOMIC RESEARCH ON WILDLIFE

In the task of rehabilitating the wildlife resources of the country, research plays the fundamental role of providing scientifically tested methods of procedure. Investigations of the food and habitat requirements and of the economic status of wildlife and studies of methods of maintaining and developing desirable food and cover conditions for the various species are essential to intelligent game management, practical development of refuges, and efficient land utilization. Food-habit studies have made important contributions in furthering the restoration of waterfowl, fostering an abundance of upland game and other desirable species of wildlife, and suppressing forms that are injurious to man's interests.

WATERFOWL-MANAGEMENT INVESTIGATIONS

PROPAGATION OF FOOD AND COVER PLANTS

A comprehensive and well-illustrated Technical Bulletin (No. 634), entitled "Food and Game Ducks in the United States and Canada," was published to assist refuge managers, State conservation agencies, and others seeking to improve waterfowl habitats. In it the fact is stressed that much of the failure and wasteful expenditure that characterized former efforts to improve the food resources of game ducks is avoidable, and that applying information developed by research will reduce errors, expense, and disappointment. Plans for improving waterfowl-food resources will be aided by a knowledge of the three types of information contained in the bulletin: (1) Relative values to waterfowl of the various marsh and aquatic food plants in different regions; (2) the habitats, ranges, and identification of the more important species utilized as food; and (3) principles of plant propagation and marsh management. Recommendations on plantings for waterfowl areas having deficient supplies of natural foods were presented in a leaflet (BS–125) entitled "Natural Plantings for Attracting Waterfowl to Marsh and Other Water Areas."

ECOLOGICAL STUDIES OF FOOD AND COVER PLANTS

In cooperation with the Fish and Game Commission of Utah, a survey was begun to determine the chemical, physical, and biological conditions of waterfowl areas in the State and the possibilities of the development of these areas. Studies of the physical and chemical conditions of soil and water that influence the growth of aquatic duck foods on the Bear River Refuge indicate that the controlling factors are mainly physical (depth, muck deposition, and turbidity). Saline clay soils are not so productive of aquatics, regardless of the depth or turbidity of the water, as saline soils covered with a deposition of organic muck. Both laboratory experiments and field analyses indicated that this is due to the action of muck as an inhibitor to the infiltration of salt from the subsoil. During the growing seasons of aquatics the turbidity is so great on most of the refuge that light, which is essential to photosynthesis, seldom penetrates beyond 30 inches. Consequently, the best growth is in 1 to 2 feet of water, and

deeper areas, such as channels and borrow pits, are usually without aquatic plants of any sort. Local variations in chemical conditions of the water appear to be relatively unimportant in determining the quantity of aquatic food produced.

Intensive studies were conducted of marsh and swamp areas in Louisiana to determine the major vegetational types and their ecological relationships. Controlled water impoundment was found important in producing and making available waterfowl foods in certain marsh areas. Controlled burning associated with limited cattle grazing was also found to be a useful management practice.

Refuges were inspected and general reconnaissance of wildlife (principally waterfowl) areas was conducted in a number of other States for the purpose of recommending improvements or appraising their suitability for refuge purposes. Botanical discoveries of interest made during the course of several years of refuge reconnaissance were summarized in an article prepared for outside publication.

PREDATOR-WATERFOWL RELATIONSHIPS

Observations in waterfowl habitat indicate that under certain conditions some of the predatory enemies of ducks and geese may seriously affect their abundance. On the Crescent Lake Refuge, Nebr., the hatching success was found to be lower than on any other refuge studied intensively, owing predominantly to bull snakes. Experiments were conducted for the control of these reptiles, and some success was attained in the use of specially designed traps. At the Malheur Refuge, Oreg., nesting losses were caused principally by predators, chiefly ravens and coyotes. Studies on the Lower Souris Refuge, N. Dak., for the third successive year indicated that the skunk, still the outstanding predator affecting waterfowl on this area, should probably be further suppressed and that the mink was a more important factor than formerly. Carefully conducted crow control on this refuge seemed to have beneficial results.

The results of various nest-history studies were summarized in a paper presented at the Fourth North American Wildlife Conference, held in Detroit, Mich., in February. Including the histories of more than 7,600 nests of 13 species, the paper disclosed that on areas studied the average degree of nesting success for waterfowl is 60 percent, the chief predators, in order of importance, being skunks, bull snakes, crows, magpies, coyotes, and snapping turtles.

SUPPRESSION OF WATERCHESTNUT

For several years the Bureau has pointed out the necessity of controlling waterchestnut, or water caltrop (*Trapa natans*), in freshwater parts of the tidal Potomac River. This Eurasian plant, which is impeding shallow-water navigation, has also destroyed approximately 10 square miles of valuable waterfowl feeding grounds in the Potomac and is a serious menace to fishing, swimming, and boating. Cooperation of the War Department was obtained in undertaking a 10-year program of eradication. C. C. C. labor was made available and has successfully used manual methods in eradicating the plant from several local areas. The use of certain chemical sprays was found to be effective in control during the 2-week period immediately

prior to the earliest maturity of the fruit, which in the vicinity of Washington, D. C., is the first 10 days in July.

Studies were also made to determine the value of various chemical sprays, mowing, and water agitation as means of controlling other undesirable marsh and aquatic plants.

ARTIFICIAL PROPAGATION OF WATERFOWL

Experiments in the artificial propagation of both Canada geese and redhead ducks were undertaken to make available data relative to proper incubation and rearing techniques. Eggs that would normally have been lost in the wild were collected and electrically incubated. Information was obtained on incubation temperatures and relative humidities, stages in the development of embryos and air cells, loss of moisture, and egg anatomy. It was found that both the size of the air cell and the egg weight are good indices to the stage of development. Young birds hatched by artificial incubation were reared, and detailed measurements were taken weekly to determine age indices, which will be of value in management.

MOSQUITO CONTROL IN WILDLIFE HABITAT

Studies were continued to determine the possibility of employing biological and other methods of controlling mosquito populations in waterfowl habitat. Mosquitoes at times so menace the health and comfort of man that efforts to control them are imperative. The use of methods that are nondestructive to waterfowl has been found in many instances the best solution of a double problem—that of mosquito control and wildlife conservation.

Efforts are being made with some degree of success to control the breeding of mosquitoes in sheet water or in temporary pools by stabilizing water depths, so as to insure at all times the presence of fish and other natural enemies of mosquitoes. This sometimes involves connecting scattered pools with permanent bodies of water, which is being accomplished in most instances with little or no reduction in water levels. In setting up extensive projects for mosquito control it has become apparent that each area should be treated as an individual problem and control methods should be adapted to local waterfowl conservation or other conditions.

Continued quadrat studies in Delaware marshes, particularly in and near the Bombay Hook Refuge, showed that the desirable flora and fauna are decidedly more prevalent on natural marsh areas than on adjacent ones that are ditched. The results so far obtained indicate that drainage in that area is definitely detrimental to wildlife, since it not only removes water but eliminates all forms of life dependent directly upon it, thus having far-reaching effects on fur animals, migratory birds, and fishes. At the twenty-fifth annual meeting of the New Jersey Mosquito Extermination Association, at Atlantic City, a representative of the Bureau presented a paper on the subject, the text of which was later made available in a leaflet (BS–119). At the North American Wildlife Conference papers were presented by members of the staff under the titles "Can Mosquito Control Be Correlated with Wildlife Conservation?" and "The Effect of Lowering Water Levels on Marsh Wildlife," the latter (a technical contribution) con-

taining the results of investigations on the effects of drainage on the basic ecology of marsh areas.

LABORATORY RESEARCH IN FOOD HABITS

The 6,224 units analyzed in the food-habits research laboratory represented 149 species of amphibians, reptiles, birds, and mammals, and included the following: Stomach contents of 3,041 birds (95 species), 2,302 mammals (29 species), 237 snakes (17 species), 3 turtles (1 species), 12 lizards (1 species), and 7 salamanders (1 species); 274 droppings of mammals (6 species), 214 droppings of birds (1 species), and 98 pellets of birds (6 species); 30 den-material samples of mammals (3 species) and 5 nest-debris samples of birds (3 species); and 1 sample of material regurgitated by a bird. Many identifications of plants and seeds, insects, reptiles, bones, and hairs were made for research workers in Federal and State agencies and private institutions. Two leaflets, Outline of Procedure for Recording Data Obtained in Stomach Examinations (Bi–1515) and Preparation and Identification of Plant Specimens in the Bureau of Biological Survey (Bi–1518), were issued for the guidance of students of food habits.

BIRDS

An important contribution, Food Habits of North American Diving Ducks, was issued as Technical Bulletin 643. It is based on field studies and on analyses of the stomach contents of 6,665 adults and 140 juveniles of 22 species of inland divers and sea ducks and presents information basic to the conservation and restoration of these species.

A paper entitled "Food of Some Uncommon North American Birds," contributed to The Auk (April), discussed species that are now extinct or so rare that stomachs will no longer be obtainable for analysis. Among these were the roseate spoonbill, great white heron, trumpeter swan, emperor goose, masked bobwhite, Eskimo curlew, passenger pigeon, ivory-billed woodpecker, and Carolina parakeet. To provide correspondents with an outline of methods of attracting birds about the home grounds and with references to available literature on the subject a leaflet (BS–131) was issued. A manuscript for a Farmers' Bulletin, Attracting Birds, was returned to the Bureau at the close of the year as the publication funds were exhausted. It is planned to issue it early next year as a Conservation Bulletin of the Department of the Interior.

MAMMALS

The report on a comprehensive food-habits study of the coyote was prepared, based on the examination of the contents of 14,829 stomachs collected in 17 States over the 5-year period 1931–35. In the West, the coyote is an important predator on livestock, poultry, and desirable forms of wildlife. Offsetting its unfavorable reputation to some extent, the results of this study indicate that more than three-quarters of its feeding (on rodents and carrion) is beneficial or nonharmful to man and about one-fifth involves domestic stock, poultry, deer, and wild birds of direct economic value. At the close of the year there was in press Circular 529 on the food of the prairie

dog. Progress on a study of the food habits of bobcats was made by the analyses of 797 stomachs at the Denver laboratory.

REPTILES AND AMPHIBIANS

Investigations of the economic status of snakes in the George Washington National Forest, Va. and W. Va., were conducted by a study of 418 specimens of copperheads, timber rattlesnakes, pilot black snakes, common black snakes, hognose snakes, and common water snakes, collected through the cooperation of the Forest Service. The results were made available for publication in the Transactions of the Fourth North American Wildlife Conference. The contents of 50 stomachs of bull snakes were analyzed to determine the predatory relationship of this species to nesting waterfowl.

COOPERATIVE FOOD-HABITS RESEARCH

COOPERATIVE INVESTIGATIONS WITH WILDLIFE-RESEARCH UNITS

In cooperative research on the food habits of birds and mammals, conducted jointly with 8 of the 10 cooperative wildlife research units, 1,336 examinations were made of animals of 18 species. Three units (Alabama, Virginia, and Ohio) detailed students to perform analyses in the Bureau's laboratory at Washington, where they were aided by supervision of the headquarters staff, the central reference collections, and various laboratory facilities. Other units submitted material for examination. For the Alabama unit, 520 stomachs of 10 bird and 4 mammal species were examined. These included 220 gray foxes, 121 wild turkeys, 67 mourning doves, 27 bobwhite quails, 40 opossums, and smaller numbers of other species. A leaflet (BS–133) was issued, entitled "A Preliminary Investigation of the Food Habits of the Mourning Dove in Alabama," prepared by the Alabama organization with the aid of the Bureau. For the Virginia unit, 555 stomachs of 4 species of birds, including 269 of the bobwhite quail and 247 of the wild turkey, were examined. For the Ohio unit, the student cooperator examined 79 fox squirrel stomachs, and a report on plant histology as an aid in squirrel food-habits studies, prepared in cooperation with a staff member, was submitted for outside publication. For the Utah unit, 77 sage-hen stomachs were examined in a preliminary study of the food habits of this bird. Examinations for other units included those of stomachs of 25 ruffed grouse and 7 white-tailed deer for Pennsylvania, of 18 feral house cats and 19 skunks for Oregon, of 9 prairie chickens, 2 wild turkeys, and 7 white-tailed deer for Texas, and those of gullet samples of 15 turkey vultures for Iowa.

INVESTIGATIONS ON THE GEORGE WASHINGTON NATIONAL FOREST

Studies of ruffed grouse food habits in the mountains of Virginia were summarized in a progress report, Circular 504, entitled "Early Winter Food of Ruffed Grouse on the George Washington National Forest." The contents of 185 stomachs collected early in winter disclosed that about 85 percent of the food at this season was derived

from 20 different plants. A study of the habitats and light requirements of these plants demonstrated that wooded areas with open canopies interspersed with clearings furnish the best feeding grounds. The data obtained will be useful in improving grouse habitats in this and adjacent forests.

A related progress report on the early-winter food preferences of the wild turkey on this forest was submitted for publication in the Transactions of the Fourth North American Wildlife Conference. The nomadic feeding habits of this bird take it into diverse environments, and the ideal habitat appears to be a combination of mature forest having relatively close canopy and considerable open woodland with occasional clearings or fallow fields.

Much of the good black bear territory in Virginia is now within the boundaries of the George Washington National Forest, an area in which this mammal should be perpetuated. The results of an analysis of the early winter food showed that in this forest during the early winter season this bear is largely vegetarian. Oaks, the dominant tree growth on the forest, apparently contribute an abundance of food; deerberry and tupelo are also important.

AID TO FEDERAL, STATE, AND OTHER AGENCIES

A total of 276 unit examinations were made for the Forest Service, including stomachs of 98 snakes of 12 species, 85 ruffed grouse, 39 white-tailed deer, 16 mule deer, 16 black bears, and smaller numbers of other animals. For the Soil Conservation Service, 88 California quail stomachs, as well as a number of other bird and mammal stomachs and bird pellets, were analyzed, to aid in determining what plants have dual value as food for wildlife and as soil binders. For the National Park Service stomachs of 35 mule deer and 7 Mount Lyell salamanders were examined.

To aid the Michigan Commission of Conservation in its wildlife-management studies, 235 otter droppings and 88 stomachs of 8 other mammals, including 45 coyotes, 18 bobcats, and 17 foxes, were examined. For the Texas Game, Fish, and Oyster Commission, 13 raccoon stomachs were examined. A collaborator assigned by the New York Conservation Department analyzed the food of 89 ruffed grouse and 193 ring-necked pheasants collected in the State. For the California Department of Natural Resources, 37 stomachs of several species, mainly bobcats, were examined; for the Vermont Department of Conservation and Development, 13 bobcat stomachs; and for the New Mexico State Game and Fish Commission, a number of merganser and antelope stomachs.

Cooperation was extended to educational institutions in the analyses of the stomach contents of various birds, as follows: Several series of waterfowl and robins for Cornell University; hawks for the University of Arkansas; flickers for the University of California; 40 jacksnipes for the Illinois Natural History Survey; 26 spruce grouse for the Royal Ontario Museum of Canada; and 6 sooty grouse, 2 black brants, and 2 harlequin ducks for the Golden Gate Museum at San Francisco.

Special examinations for a number of private individuals and agencies were made of 69 stomachs, pellets, and nest-debris samples of 20 species of birds and of 44 stomachs of 3 species of mammals. Nest-

debris samples of the barred owl were analyzed for the National Association of Audubon Societies, and stomachs of 34 mule deer and 9 elk for the Federal aid in wildlife-restoration project in Colorado.

FIELD INVESTIGATIONS OF MIGRATORY GAME BIRDS

Limits of the nesting period of the white-winged dove in Arizona were investigated for the purpose of determining a suitable open season, and attention was given to the food habits and activities of the band-tailed pigeon. Of the latter, 225 stomachs were examined, bringing the available records to 350. In the San Joaquin Valley, Calif., a preliminary study was undertaken of the attack of *Protocalliphora* larvae on nesting doves, and in the Southeastern States work was continued on the food habits of the mourning dove.

STUDIES OF NUTRITION OF UPLAND GAME BIRDS

The Bureaus of Biological Survey and Animal Industry cooperated in studies to determine the nutritional requirements of the bobwhite quail and the nutritive qualities of its native foods. More than 100 breeding birds were supplied by the Virginia Commission of Game and Inland Fisheries for the experiments. At the close of the year there was in press, in the Yearbook of Agriculture, 1939, an article prepared by the Bureau on the nutrition of upland game birds.

FIELD STUDIES OF INJURIOUS BIRDS AND MAMMALS

THE CROW

The beneficial and harmful activities of the crow continued to be a controversial subject among farmers, sportsmen, and bird students. In order to obtain added information on its economic status, studies were conducted in various parts of the country. A leaflet (BS–123), entitled "Crow Damage to Fall Grain Crops in Oklahoma in 1937," was issued. Farmers' Bulletin 1102, The Crow in Its Relation to Agriculture, published in 1920, was brought to date for publication as a revised edition.

THE ENGLISH SPARROW

The manuscript for Technical Bulletin 711, entitled "The Economic Status of the English Sparrow," was submitted for publication, and an illustrated leaflet (BS–121) presenting information on the construction of home-made sparrow traps was issued.

OTHER BIRDS

Transformers used in connection with rural electrification work have frequently been put out of service because of short circuits caused by roosting birds. In cooperation with the Rural Electrification Administration and a transformer manufacturer, effective plans for altering the transformers to prevent birds from roosting on them were devised. Following an extremely dry winter season, both game and nongame species of birds inflicted serious damage to winter-grown green crops. Part 2 of a bird-control manual outlining control procedure was issued as a guide for county agricultural commissions of California.

INJURIOUS MAMMALS

The results of a study to determine the extent to which gray foxes prey upon bobwhite quail under conditions regarded as favorable to heavy predation were summarized in two reports entitled "The Summer Food Habits of Gray Foxes at the Camp Lee Quail Preserve, Virginia," and "Behavior of Gray Foxes in Raiding Quail Nests." It was found that foxes preyed upon bobwhites to some degree in this area but that their depredations were not sufficiently extensive to prevent the maintenance of a satisfactory quail population.

RESEARCH IN FUR PRODUCTION

PRESENT CONDITIONS IN FUR PRODUCTION AND THE FUR TRADE

NEED FOR PROFITABLE STOCK

Unsettled conditions in Europe and the Orient were partly responsible for a depression in the fur market, but domestic financial conditions, labor troubles, and a decline in consumer demand were contributing factors. Fur buying on a large scale is dependent on settled conditions in world affairs. Fine furs, however, which are not being produced in quantities large enough to supply the market, still command high prices.

Despite warnings from the Biological Survey, fur-animal producers for a number of years have largely sacrificed quality for quantity. Realizing now, however, that profitable stock is absolutely necessary to success, they have begun to reduce the number and improve the quality of their breeding animals. Reports indicate that many who were engaged in silver-fox raising have discontinued operations through inability to meet market requirements. This is not yet true of mink raising, and it is hoped that producers will profit by the experience of the fox breeders.

STATISTICS ON FUR PRODUCTION

After assembling data for several years on the annual production of furs in the United States, from reports of State conservation commissions and from other sources, the Bureau issued the results in a leaflet (BS–140), A Survey of the Annual Fur Catch of the United States. With the assistance of W. P. A. workers, figures on the number of predatory fur animals taken by the Bureau and cooperators from 1916 to 1938 were assembled and tabulated, the number of fur animals imported into the United States from 1931 to 1937 was compiled, and a survey of fur-animal production in captivity, including rabbit raising, was conducted. Among importations of live fur animals during the calendar year 1938 were 1,691 silver foxes, 522 minks, 8 fishers, 6 martens, and 5 nutrias, in addition to rabbits, raccoons, lynxes, and leopards. The annual summary of State laws on the trapping, possession, and sale of fur animals and their pelts or other parts was issued as a leaflet (BS–118), primarily as an aid to Federal investigators and law-enforcement officials, but also to answer inquiries constantly received from State game departments, individual trappers, conservationists, and others desiring the information.

Final arrangements have been made to include in the census of the United Otates and Alaska for 1940 questions on the number of breeding animals and young produced both by silver foxes and by minks. This will be the first comprehensive survey of the extent of fur farming, and it will come at a most opportune time. Former lack of statistical background has frequently made financial and governmental support for the industry uncertain and inadequate.

COOPERATIVE RESEARCH ON FUR ANIMALS

REPRODUCTION STUDIES

A cooperative study of reproduction in minks and muskrats was inaugurated by the Bureau with Swarthmore College, and 10 distinct experiments with a large colony of minks were carried to a successful conclusion. More than 2,500 permanent slides of vaginal smears and 600 slides of serial sections of tissue were prepared, and although much of the material, including 100 tissues, remains to be analyzed, an important finding resulted on pseudopregnancy.

The female mink ovulates only after copulation or after a fight with a male, but pregnancy may not result. In this case she experiences a period of pseudopregnancy, and since this continues until after the breeding season she cannot produce young that year. Matings or attempted matings early in the season result in a high percentage of pseudopregnancies. It was found possible to determine receptivity in a high percentage of females by a study of vaginal smears taken at 3- or 4-day intervals. One breeder reports that by using this method he had success with 84 of 85 females that accepted service. The studies also disclosed that sperms may reach the Fallopian tubes before copulation ends and that the ovarian capsule then becomes greatly engorged, functioning, apparently, as an aid in fertilization.

As an aid to understanding reproduction in the muskrat, extensive studies were made of the corpus luteum of the species in ovarian material collected on the Blackwater Refuge, Md., during the previous trapping season.

A number of articles and manuscripts, published officially and outside, reported the results of research as noted. Among the titles were the following: Fur Animal Reproductive Cycles and Their Relation to Management, The Ovum of the Mink (*Mustela vison*), Mink Breeding Through the Microscope, Physiology of Reproduction in the Mink, and Sperm Studies as a Guide in Fur-animal Breeding Practice (Leaflet BS–138). A paper on observations of corpora lutea in the ovaries of Maryland muskrats during February and March was prepared for official publication; but as funds were exhausted, it is planned to issue it early next year as a Wildlife Circular.

Study material and assistance were furnished, not only to Swarthmore College, but also to specialists of the University of Pennsylvania for work with protozoan parasites and studies of blood in respiratory transport. Additional studies were made of the respiratory adaptations of minks and their modifications for aquatic life. As a result of these investigations two papers were published: Properties of Fox Blood for Respiratory Transport and Blood Transport in the Mink.

Reporting on cooperative research undertaken with the Department of Embryology of the Carnegie Institution of Washington, Technical Bulletin 616, The Reproductive Cycle of the Coyote, was issued.

FUR ANIMAL NUTRITION

For the Yearbook of Agriculture, 1939, a chapter on nutrition of fur animals was prepared summarizing all of the experimental feeding investigations with fur animals thus far conducted by the Bureau and other agencies and including practical suggestions on feeding.

A cooperative study of the nutrition required for growth, reproduction, and fur production of foxes and minks was inaugurated by the Bureau and Cornell University. Emphasis was placed on studies of the digestibility in minks of the common feeds and feed mixtures. Digestion experiments showed that about 85 percent of the proteins of beef and horse meat are available for minks, as also are the proteins of beef tripe and udder and canned fish. In all tests the fats were more fully absorbed than were proteins, usually to the extent of more than 90 percent. Carbohydrates in the feed materials tested also were well utilized, but a large part of the crude fiber remained undigested. Analyses showed that 90 percent of the cooked starch fed with meat, either in the form of cereal grains or as a purified product, was digested. The digestibility of the carbohydrates of cooked and raw cereal is being given further study. Toward the end of the year similar tests with foxes were begun.

In an experiment undertaken to determine the vitamin-A requirements for the maintenance of adult minks, six animals were maintained for 5 months on a ration devoid of that vitamin, except as supplied by frozen horse meat. X-ray photographs were taken monthly to determine whether bladder stones had developed, but nothing abnormal was observed.

In observations on the nitrogen requirements of adult minks, it was found that rations containing more than 14 percent of protein and supplying at least 2 grams of nitrogen each 24 hours permitted nitrogen re-storage by the body, but that those containing only 6 percent of protein resulted in negative nitrogen balances. Additional work must be done to establish the minimum nitrogen requirement for maintenance.

FUR-FIBER INVESTIGATIONS

At the Agricultural Research Center, a study was begun in cooperation with the Bureau of Animal Industry to determine by microscopical examination the physical properties of fur and the factors that contribute to the production of fur of superior quality. Special attention was given to fur fibers of the silver fox, mink, marten, and Karakul sheep. A review was made of all the American and foreign literature covering similar investigations.

Through persistent research, media have been found that are suitable for making both temporary and permanent mounts to reveal the inner structure of the fibers, especially pigmentation, and to emphasize their outlines. In heavily pigmented and medullated fibers fine relationships between scales cannot be distinguished by direct observation, and in such cases the details were revealed by casts and

photomicrographs. The precision of this method will undoubtedly prove of importance in the identification of unknown fibers.

KARAKUL SHEEP AND OTHER INVESTIGATIONS

The study of Karakul sheep, which is cooperative with the Bureau of Animal Industry, gave particular attention to the selection of typical specimens illustrating size and type of curl, pattern, and luster. The year's crop of 53 lambskins, after being graded and valued according to the standard samples, was taken by a Survey representative to fur-trade specialists who also appraised them. A survey completed by W. P. A. workers under the direction of the Bureau revealed that there were 5,389 purebred and grade Karakul sheep on American farms on January 1, 1938, from which 1,051 Karakul lamb pelts were produced in 1937. Importations ran over a quarter of a million. American producers supply less than 0.5 percent of the lambskins used by the fur trade.

In cooperative research with the Bureau of Chemistry and Soils, observations were made on the effect of alternate freezing and thawing of silver fox skins immediately following pelting. No appreciable difference in either the tensile or bursting strength of the frozen and unfrozen skins was detected.

On request of the Federal Trade Commission, information concerning the real and trade names of furs, as well as information regarding fur-trade practices in general, was supplied for use in enforcing the fair-trade-practice rules for the fur industry. During this first year of operation of the rules the Commission handled over 500 cases of alleged misdescriptive advertising and made much progress in correcting the bad practices against which the rules were directed.

The Treasury Department was assisted in proceedings before the Court of Customs and Patent Appeals between the Federal Government and fur importers. Bureau representatives furnishing scientific and other data for use in preparing the cases, in which duties amounting to many millions of dollars are involved.

FUR ANIMAL EXPERIMENT STATION, N. Y.

The construction program at the Fur Animal Experiment Station, Saratoga Springs, N. Y., which was made possible by W. P. A. funds, has been in operation for 2 years, and its completion is expected during the coming year. The station property was enclosed with a 6-foot chain-link fence, the residence for the director was completely remodeled, two large colony houses for minks were constructed, additional fox and marten pens were completed, and the premises were graded and landscaped. Although this work has retarded the research program to some extent, the improvements when completed will provide much better facilities for administrative and experimental work. Extended experiments were conducted with foxes, minks, and martens in testing the merits and relative costs of various feed preparations.

A search for more humane, efficient, and economical methods of killing foxes was continued. Technique developed at the station some years ago for electrocuting fur animals, together with improved

equipment, was found to operate quickly and humanely. Time records under this method kept on 24 foxes showed that death occurred within 2.7 to 6.7 seconds.

Reports on studies included three leaflets, An Efficient Trap for the Fox Ranch (BS–127), A Feeder for Foxes (BS–128), and Seasonal Fox Rations and Quantities to Feed (BS–130). The director of the station made an address on research work with fur animals at the annual short course for fur-animal breeders at the Ontario Veterinary College, Guelph, Ontario.

RABBIT EXPERIMENT STATION, CALIF.

Increasing number of rabbit breeders and of 4–H Club members, Future Farmers, and high-school and college students interested in raising rabbits visited the Rabbit Experiment Station, Fontana, Calif., for advice and special instruction on breeding, feeding, and management. The fourth annual field day, held at the station on May 21, was attended by 350 southern California rabbit breeders. Requests for information from breeders from practically every State and from several foreign countries, as well as from feed mills relative to rabbit rations, increased in volume.

Based on results of feeding experiments, a leaflet (Bi–1520), Rabbit Rations and Quantities to Feed, was prepared for answering correspondence from various sections relative to rations for herd bucks, does and litters, dry does, and young being developed for breeding purposes. Extensive experimental research demonstrated that rabbits require higher protein content in their diet than was formerly considered necessary.

Twenty-five different rations were used in the experimental herd in connection with mucoid-enteritis studies, and considerable variation in mortality occurred in the different lots. Present information suggests that the vitamin content of the ration and the quality of roughage are fertile fields for future research.

An experiment was begun to obtain fundamental knowledge as to the effect of the woolly gene on the quality and commercial value of rabbit fur and pelts and on the development of the animal and the quality of carcass.

Special equipment was developed for housing rabbits in desert and other areas where high temperatures prevail and water is unavailable for controlling rabbitry temperatures. Outdoor hutches, each equipped with an underground compartment in which the temperature averages about 15° to 20° F. lower than that of the hutch and in which the floor space is about half that of the hutch, were found adequate for accommodating doe, litter, and nest box. In a 2-year study with this type of equipment, when maximum temperatures reached 108° to 117° F. no heat mortality was noted.

Information developed on breeding, feeding, and management, and on equipment for the rabbitry was prepared for revising Farmers' Bulletin 1730, Rabbit Production. The results of several years of experimental studies with various types of hutch floors were reported in a leaflet (BS–139), Rabbit Pen Construction in Relation to Sore Hocks. Several papers based on nutritional studies were prepared for rabbit journals, farm papers, and industrial bulletins. An article on feed requirements of rabbits was prepared for the World's

Poultry Congress, held in Cleveland, Ohio, in July 1939. The director of the station reported on the experimental program in addresses given at the National Convention of Rabbit Breeders, in Columbus, Ohio, and at rabbit clubs at Chicago, Ill., and San Diego and Los Angeles, Calif.

FUR ANIMAL FIELD STATION, MD.

Fur animals occur naturally on many of the national wildlife refuges, where they must be managed so as not to jeopardize migratory waterfowl and the resident species of upland game birds and mammals. The pelts of fur animals have such high commercial value that a considerable income can be realized from fur on all these refuges. Fur animals produced there are valuable also for restocking as well as for scientific study in obtaining fundamental knowledge not otherwise available. On the Blackwater Refuge, Md., the Fur Animal Field Station is gaining definite knowledge on breeding seasons, prime fur periods, feed requirements, carrying capacity of marsh areas, and many other practical problems in the management of fur resources on Federal refuges in general.

Another careful count of all muskrat houses on the entire Blackwater marsh area of 5,406 acres was made in an effort to correlate pelt production and house density per acre. The houses, old and new, large and small, totaled 29,893. The annual catch of 21,856 pelts, segregated by color and by trapping areas, showed 9,896 black, 10,370 brown, and 1,590 kit and damaged pelts.

Twelve 100-foot-square quadrats were staked out last August in various types of marsh selected for a study of the changes taking place in plant growth. Each of the quadrats was photographed, and a detailed study was made of the vegetation and the abundance of muskrats. Additional muskrat pens and enclosures were constructed, and much attention was given to the factors affecting muskrat breeding in captivity, including size of pen, presence or absence of water, types of nest boxes, heat, drought, feeds, disturbing noises, handling, and polygamous and monogamous mating.

Of a large variety of truck and field-crop plants fed to determine the likes or dislikes of muskrats, the feeds most relished were carrots, crimson clover, green pea vine, hairy vetch, corn, raw peanuts in the shell, live and dead minnows, and live crabs.

A pair of nutrias, 6 months old, purchased and placed in a pen on the refuge, produced five young on March 2 and were expected to produce a second litter in August. Further observations and studies of this South American rodent are planned to determine its suitability as a fur producer in marsh areas of the United States.

RESEARCH IN WILDLIFE-DISEASE CONTROL

FUR-ANIMAL DISEASES

Research on experimental test animals, correlated with results obtained on cooperating commercial fur farms, added to the knowledge of epizootic diseases and developed facts for application in restricting serious losses. Until recently, inadequate laboratory facilities made it necessary to test on the operating farms of collaborators biological products designed for disease control, and frequently the

results thus obtained were found more useful than experimental findings in the laboratory alone. The possibility of accidental outbreaks among valuable stock where these tests were being conducted made it necessary to proceed with great caution and to extend the investigations over a period of years.

SILVER FOX DISTEMPER

Since homologous serum alone does not produce lasting immunity against canine distemper in silver foxes, efforts were made to determine the value of other biological control preparations. Tissue vaccines from several sources were administered experimentally to supplement the transitory protection of the serum. The results demonstrated the value of using chemically treated tissues containing the virus. Experimental research was conducted along this line for reducing losses from distemper, and plans were made for checking the use of phenol-, choloroform-, and formalin-treated tissues and the attenuation of the live viruses in such manner as to safeguard their use and make them productive of long-time protection. Research conducted in cooperation with the University of Minnesota facilitated accurate diagnosis.

MINK DISTEMPER

In collaboration with outside institutions and fur farmers in investigations of distemper in minks, formolized tissue vaccine was given extensive tests. Administered under proper conditions, this new product was shown to have considerable protective value. Tests also are under way to ascertain possible variations in distemper virus from different sources and from various species of animals.

RABBIT DISEASES

Field tests in specially constructed and screened hutches demonstrated the transmission of the virus of myxomatosis by mosquitoes. Although popularly believed to be a mosquito-borne disease, this was the first scientific evidence that myxomatosis is transmitted in epizootic form by these insects. The fact that the disease is of seasonal occurrence suggests that wild rodents may serve as a reservoir for the infection and that it is carried to domestic rabbits when mosquitoes are prevalent. Efforts are being made to determine the host or hosts that carry the infection from one season to another.

During the past year heavy losses were caused by a disease, apparently new in commercial rabbitries, spoken of as hemorrhagic enteritis. Bacteriologists at the University of California at Los Angeles are aiding in a study of its etiology, but no specific organism has yet been isolated that will reproduce the disease in test animals.

GAME-BIRD DISEASES

BOTULISM IN WATERFOWL

Research was continued at the Bear River Refuge, Utah, on factors responsible for widespread losses for botulism. A significant finding was that various forms of vegetation have a marked effect on the development and accessibility of the toxin produced by the causative

organism (*Clostridium botulinum*) so that the establishment of desirable types of plants that inhibit the growth of this organism may now be recommended. To be encouraged are submerged types of vegetation that in rapid growth liberate oxygen freely and so check the growth of the anaerobic germ. To be discouraged are *Cladophora* and like algae, as the rapid decay of these plants and of the abundant minute forms of animal life enmeshed in them furnishes favorable media for the organism's growth.

A leaflet (BS–120) entitled "Botulism, a Recurring Hazard to Waterfowl," was issued to give a history of the outbreaks of this disease and offer suggestions for safeguarding waterfowl, and a paper on American vultures and the toxin *Clostridium botulinum* was prepared for the Journal of American Veterinary Association.

Observations made on Malheur Lake and other areas in southeastern Oregon indicate that the presence of livestock may be helpful in preventing outbreaks of botulism, presumably by agitating the water and thereby preventing local concentrations of toxin.

OMPHALITIS IN UPLAND GAME BIRDS

Outbreaks were investigated of a disease attacking young game birds raised on propagating farms. This infection, omphalitis, recognized as a plague in domestic chicks, also becomes epizootic among young chukar partridges and quails. Although cures are impracticable, good results in prevention were obtained through fumigation of incubator rooms and brooders. With care, the incubator and the room in which it is kept may be effectively fumigated while in operation.

FEDERAL AID IN WILDLIFE RESTORATION

The Federal Aid to Wildlife Restoration Act (50 Stat. 917), also known as the Pittman-Robertson Act, became effective on July 1, 1938, with an appropriation of $1,000,000, and progressed satisfactorily during the year. The program thereunder has had excellent support from all conservation agencies and organizations, and it is expected that when fully operative it will have far-reaching effects on the Nation's wildlife resources. A new Division of Federal Aid in Wildlife Restoration was organized to handle the details of the program, and regional inspectors were appointed to cooperate closely with the State game departments in examining proposals and assisting the States in operations under the act. The text of the regulations for carrying out the act was published in Service and Regulatory Announcement B. S. 91, and the purpose of the act and the procedure thereunder in Miscellaneous Publication 350, The Wildlife Restoration Program Under the Pittman-Robertson Act of 1937.

The act authorizes annual appropriations of not to exceed the excise tax on sporting arms and ammunition, which yielded a revenue of $2,976,019 this year. The funds appropriated are apportioned to each State on the basis of its area and the number of its hunting-license holders. The allotments may be obligated for a 2-year period, after which unexpended and unobligated balances are to be made available for carrying out the provisions of the Migratory Bird Conservation Act. The States contribute 25 percent of the cost of their wildlife restoration projects, each of which, to be approved, must be substan-

tial in character and design. The projects include research into problems of wildlife management and restoration of areas of land or water to provide additional benefits for wildlife. All lands purchased are owned by the States and are to be maintained by them. The fish and game commissions are named as the cooperating State agencies.

The act provides that no State may participate until it has passed laws for the conservation of wildlife, including a prohibition against the diversion of hunting-license fees to any other purpose than the administration of the State fish and game department, and until it has assented to the provisions of the act, except that until the final adjournment of the first regular session of the State legislature held after the passage of this act, the assent of the Governor is sufficient.

During the first year of the operation of the act, 43 States became eligible for participation—in 42, legislation was adopted assenting to the provisions of the act; and in 1, a bill was introduced and awaits action by the legislature still in session. Only 5 States—Florida, Georgia, Louisiana, Montana, and Nevada—failed to enact laws necessary to permit participation. In all, 87 projects, many extending beyond the present fiscal year, were submitted by 37 States. These would require $1,819,819 for completion. Of the $1,000,000 appropriated to carry out the provisions of the act in its first year, $343,932 was set aside in the Federal Treasury to cover 58 projects approved in 31 States. Final approvals of the 29 others were delayed, pending further investigations.

The types of projects were as varied as the problems of the State game departments. Of the 87 submitted, 30 involved research in wildlife management; 28, development of natural conditions for wildlife; 28, acquisition of lands by purchase or lease; and 1, a combination of research and development. The features for each State are shown in table 2.

TABLE 2.—*Nature, extent, and estimated cost of initial Federal aid in wildlife restoration projects*

State, available 1939 funds,[1] and type of project	Purpose	County	Years duration	Cost estimate	
				First year	Total
Alabama ($17,884):					
Research	To inventory the principal wildlife species.[2]	All	3	$8,480	$30,700
Arizona ($24,816):					
Research	To determine factors limiting the wild turkey.	do	1	7,565	7,565
Development	To reclaim abandoned well to supply water for desert wildlife.	Maricopa	1	255	255
Do	To reestablish wild turkey breeding stocks.	Pima, Cochise, Graham.	1	775	775
Colorado ($29,918):					
Research	To study summer-winter food of deer and elk.	All	1	6,945	
Do	To select sites for reestablishing beaver colonies.	do	1	2,396	2,396
Acquisition	To purchase winter range for deer and elk.[2]	Gunnison	2	13,940	19,280
Delaware ($1,821):					
Research	To determine the value of seedstock areas in maintaining wildlife.	All	5	1,821	16,000

[1] State supplied 25 percent, Federal Government 75 percent.
[2] Project under consideration at end of year.

TABLE 2.—*Nature, extent, and estimated cost of initial Federal aid in wildlife restoration projects*—Continued

State, available 1939 funds,[1] and type of project	Purpose	County	Years duration	Cost estimate	
				First year	Total
Florida ($16,319):					
Research	To determine the possibilities of a wildlife-restoration program.	All	5	$2,400	
Idaho ($23,788):					
Development	To improve sage grouse habitat [2]	do	1	6,560	$6,560
Do	To transplant beavers from overpopulated to underpopulated areas.[2]	do	1	10,349	10,349
Research	To determine the effect of beavers on range lands.[2]	Ada, Elmore, Owyhee.		3,676	3,676
Illinois ($34,853):					
Research	To make economic survey of fur resources.	7	2	1,793	4,865
Do	To study the correlation between availability of food supplies and their use by game birds.	All	2	2,989	5,100
Do	To study game and fur management methods on farms.[2]	Champaign	4	880	11,000
Do	To study the effect of management practices on wildlife concentrations on refuges.[2]	Cumberland	4	900	10,680
Do	To study waterfowl and upland-game management.[2]	Lee			2,100
Acquisition	To purchase refuge for upland game.[2]	Cumberland	1	13,002	13,002
Do	To purchase waterfowl and upland-game refuge.[2]	Lee	1	63,180	63,180
Development	To improve food and cover on farm lands.[2]	Champaign	4	2,236	3,265
Do	To improve habitat on wildlife refuge.[2]	Cumberland	4	3,233	4,344
Do	To improve waterfowl and upland-game refuge.[2]	Lee			35,710
Indiana ($44,280):					
Acquisition	To purchase refuge for upland game and migratory waterfowl.	Posey	1	20,600	20,600
Iowa ($22,479):					
Acquisition	To purchase waterfowl, fur-animal, and upland-game refuge.[2]	Worth, Winnebago	2		27,641
Kansas ($22,546):					
Acquisition	To purchase additional lands for established State game preserve.	Finney	1	9,450	9,450
Kentucky ($16,208):					
Acquisition	To purchase deer and upland-game refuge.	Pike	1	5,570	5,570
Do	do	Harlan	1	10,637	10,637
Maine ($14,708):					
Research	To determine measures for improving lakes for wildlife.	All	4	2,892	22,633
Development	To improve lakes as recommended from research.	do	4	5,866	50,907
Massachusetts ($7,779):					
Research	To determine means of improving winter conditions for waterfowl.	4	5	5,000	25,000
Development	To improve wildlife areas on State forest.	Norfolk	1	1,604	1,604
Do	do	Hampshire	1	1,175	1,175
Michigan ($67,577):					
Research	To determine effective raccoon-management practices.	Allegan	2	2,192	4,720
Do	To coordinate game-management and farm practices.	Clinton	3	1,625	5,000
Acquisition	To purchase refuge for wildlife [2]	Tuscola	3		118,420
Do	To purchase addition to Rose Lake Wildlife Experiment Station.[2]	Clinton, Shiawaase	3		144,630
Minnesota ($35,136):					
Acquisition	To purchase addition to Carlos Avery Refuge.	Anoka	1	9,703	9,703
Do	To purchase addition to Thief Lake Waterfowl Refuge.	Marshall	1	960	960

[1] State supplied 25 percent, Federal Government 75 percent.
[2] Project under consideration at end of year.

TABLE 2.—*Nature, extent, and estimated cost of initial Federal aid in wildlife restoration projects*—Continued

State, available 1939 funds,[1] and type of project	Purpose	County	Years duration	Cost estimate	
				First year	Total
Minnesota ($35,136)—Continued.					
Development	To fence and post Carlos Avery Refuge.	Anoka	1	$2,920	$2,920
Do	To restore waterfowl and upland game on State refuges.[2]	4	5	21,553	55,077
Mississippi ($18,366):					
Development	To plant food and cover on State game preserve.	Hinds	1		267
Do	To improve food and cover and to stock national-forest wildlife areas with deer, turkey, and beaver.	4	5	11,777	41,187
Missouri ($26,998):					
Research	To survey wildlife resources	All	5	26,400	132,000
Nebraska ($27,238):					
Development	To restock and improve cover for pheasants.	do	5	13,720	
New Hampshire ($6,180):					
Research-development	To undertake experimental stocking and cover improvement on research area for pheasants, grouse, ducks, and fur animals.	Merrimack	5	6,180	34,029
New Jersey ($12,559):					
Research	To study the effectiveness of refuges in maintaining wildlife.	Warren, Hunterdon	2	2,801	3,250
Acquisition	To lease seed-stock refuges for upland game.	Warren	1	1,237	1,237
Do	To lease land for establishing food patches for deflecting deer from farm crops.[2]	Atlantic	1	605	605
Development	To plant food and cover for upland game.	Warren	1	3,611	3,611
Do	To plant food crops to deflect seasonal movements of deer from farms.	Atlantic	1	3,674	3,674
New York ($65,944):					
Research	To study management methods for pheasants, cottontail rabbits, white-tailed deer, mallards, and black ducks.	All	5	25,348	142,452
Acquisition	To purchase addition to Delmar Wildlife Research Center.	Albany	1	9,320	9,320
Do	To lease upland-game and fur-animal seed-stock refuges.	All	1	7,717	7,717
Development	To construct pathological laboratory on Delmar Wildlife Research Center.[2]	Albany	1	9,405	9,405
Do	To improve seed-stock refuges for pheasants, cottontail rabbits, raccoons, and muskrats.	All	1	3,340	3,340
Do	To revegetate State lands deficient in food and cover for wildlife.	16	10	5,333	96,980
North Carolina ($23,224):					
Development	To construct 2 dams to impound water for attracting wintering waterfowl, upland birds, and fur animals.	Richmond	1	3,018	3,018
Research	To study farm-game management.	Wake	5	9,953	55,873
North Dakota ($15,322):					
Acquisition	To purchase refuge for pheasants, grouse, partridges, and waterfowl.[2]	Kidder			5,020
Ohio ($52,023):					
Acquisition	To purchase refuge for waterfowl and upland game.[2]	Erie	2	52,023	60,045
Oklahoma ($21,137):					
Development	To restore bobwhite quail and undertake its management.	All	1	18,860	18,860

[1] State supplied 25 percent, Federal Government 75 percent.
[2] Project under consideration at end of year.

TABLE 2.—*Nature, extent, and estimated cost of initial Federal aid in wildlife restoration projects*—Continued

State, available 1939 funds,[1] and type of project	Purpose	County	Years duration	Cost estimate	
				First year	Total
Oregon ($25,667):					
Development	To transplant beavers from overpopulated to underpopulated areas.	All		$4,899	
Do	To restore sage grouse habitat	Southeastern		5,200	
Pennsylvania ($61,368):					
Research	To make economic survey of fur animals.	All	1	3,500	$3,500
Acquisition	To purchase land for game-management and refuge areas.	9	1	48,883	48,883
Do	do	Cumberland	1	8,985	8,985
Rhode Island ($972):					
Research	To study game management on demonstration areas.	Washington	5	575	5,250
Tennessee ($14,247):					
Acquisition	To purchase preserve for deer, wild turkeys, quails, raccoons, opossums, and other wildlife.	Cheatham	5–10	14,247	86,748
Texas ($61,652):					
Research	To survey wildlife resources	All	5	53,600	300,000
Utah ($21,155):					
Research	To study beaver management and stream run-off.	Summit	3	3,000	9,000
Development	To improve waterfowl conditions at Ogden Bay.	Weber	1	16,000	16,000
Acquisition	To purchase winter range for deer.[2]	Millard			77,500
Do	To purchase experiment station for deer studies.[2]	Cache	1	2,000	2,000
Vermont ($5,766):					
Research	To study bird migrations, food and cover needs, and protective measures.	All	5	5,000	25,000
Virginia ($19,637):					
Research	To learn the distribution of wild turkeys and factors influencing their abundance.	do	2	1,690	5,000
Do	To study the effect of cleared areas on wildlife populations.	do	2	950	7,575
Development	To reestablish deer on and near the Thomas Jefferson and George Washington National Forests.	12	1	10,702	10,702
Do	To restock with wild turkeys	Giles, Smyth	1	320	320
Do	To restore bobwhite quail[2]	Clarke, Loudon, Fauquier.	1	2,110	2,110
Washington ($31,253):					
Acquisition	To purchase winter range for deer.[2]	Okanogan	1	31,248	31,248
West Virginia ($19,884):					
Acquisition	To purchase game-management area.	Hampshire	1	17,540	17,540
Wisconsin ($31,652):					
Research	To learn reasons for fluctuations in quail populations.	Columbia	5	200	1,000
Acquisition	To purchase demonstration and research area.[2]	do	2	31,452	54,457
Wyoming ($20,934):					
Research	To study factors determining the abundance of Rocky Mountain bighorn sheep.	4	5	3,776	25,000
Do	To study moose-management factors in northwestern Wyoming.[2]	5	4	4,451	20,000
Acquisition	To purchase land for game refuge.[2]	Albany	3	12,000	22,500
Do	To purchase South Park Elk Feeding Ground.[2]	Teton	1	6,930	6,930

[1] State supplied 25 percent, Federal Government 75 percent.
[2] Project under consideration at end of year.

The 30 research projects were restricted to practical problems of management, including State-wide game surveys on which to base future development and management programs; studies of the rela-

tion of summer and winter ranges of big game; methods of quail, turkey, and deer management; investigations of local migrations of waterfowl; studies of factors influencing turkey populations; coordination of game-management and farming practices; management of fur resources; research on factors influencing the population of raccoons; and investigation of factors limiting herds of mountain sheep. Some worth-while results were obtained within the few months the program was under way.

The 28 development projects for improving natural conditions for wildlife covered such matters as restoring water facilities for desert game; fencing surrounding lands and developing springs to provide additional food and cover for wildlife as well as to increase the water supply for livestock; propagating food and cover plants to improve wildlife habitat on State and Federal lands; posting and fencing refuges; releasing seed stocks of game on protected areas; trapping and planting live beavers and turkeys; constructing dikes to control water on areas used by migratory birds and fur animals; and purchasing deer from States having surpluses and transporting them to protected areas deficient in seed stock.

The acquisition projects, involving the purchase or lease of lands, progressed more slowly at the start than projects of other types because of the greater time and effort needed. Of the 28 submitted, substantial progress was made on 13, involving cut-over woodlands to be dedicated to wildlife use in the Eastern and Southern States, winter range for big game in parts of the West, agricultural lands for conducting studies of the relation of farming practices to wildlife populations, and additional lands for increasing research facilities.

REFUGE-LAND ACQUISITION

Following approval of purchase by the Migratory Bird Conservation Commission, 1 new refuge of 8,000 acres was added to the national wildlife refuge system; 6 new refuges with an aggregate area of 1,521,376 acres were set aside from the public domain; and 22 refuges were enlarged through the acquisition of lands aggregating 18,539 acres.

By Executive orders increments to 5 refuges heretofore established in public-domain States were obtained by the inclusion of a total of 21,787 acres; and Executive orders were issued also for the establishment of 59 new refuges, enlargement of 8 existing refuges, and correction or modification of scope of 2 others, including 1,749,163 acres of the public domain and 132,304 acres acquired by purchase.

There have also been added to the refuge system 332,438 acres in 7 units, which were acquired by the Farm Security Administration and more recently handled by the Soil Conservation Service. Five of these refuges, namely, Carolina Sandhills, S. C.; Little Pend Oreille, Wash; Piedmont, Ga.; Moosehorn addition, Maine; and Kentucky Woodlands, Ky., aggregating 269,938 acres, are primarily suitable for upland game; while the Necedah, Wis., and St. Marks addition, Fla., containing 62,500 acres, are migratory-waterfowl refuges.

Details of the accomplishments in refuge-land acquisition are given in table 3.

TABLE 3.—*Land for refuges and related uses acquired or in process of acquisition during the fiscal year 1939 under the Migratory Bird Conservation Act, with emergency and other funds, by gifts, and by Executive order*

State and county	Refuge	Under Migratory Bird Conservation Act			With emergency and other funds			Acquired other than by purchase	Total	Acquired in previous years
		Acquired by purchase	Pending title conveyance	Total	Acquired by purchase	Pending title conveyance	Total			
		Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Alabama: Limestone, Madison, and Morgan.	Wheeler							[1] 41,800	41,800	
Arizona:										
Pima and Yuma	Cabeza Prieta							[1] 860,000	860,000	
Yuma	Kofa							[1] 660,000	660,000	
Arkansas: Arkansas, Desha, Monroe, and Phillips.	White River		6,232	6,232	3	1,417	[2 3 4] 1,420		7,652	103,036
Delaware: Kent	Bombay Hook		1,704	1,704					1,704	12,006
Florida:										
Pasco and Pinellas	Anclote [5]							[1] 155	155	
Hillsborough	Fort DeSoto							[6] 421	421	
Monroe	Great White Heron							[1] 1,000	1,000	
Jefferson, Taylor, and Wakulla	St. Marks	3,482	1,803	5,285		1,182	[2] 1,182	[7] 22,000	28,467	50,778
Georgia:										
Charlton, Clinch, and Ware	Okefenokee		833	833				[8] 16	849	292,993
Jasper and Jones	Piedmont							[7] 58,400	58,400	
Chatham	Savannah River (see also South Carolina).									5,414
Effingham	Wilson Sanctuary							[8] 1,426	1,426	
Idaho: Jefferson	Camas	1,310	533	1,843					1,843	8,691
Illinois:										
Mason	Chautauqua					496	[3 4] 496		496	3,981
Carroll, Jo Daviess, Rock Island, and Whiteside.	Upper Mississippi (see also Iowa, Minnesota, and Wisconsin).									5,256
Iowa:										
Kossuth	Union Slough	80	441	521					521	630
Allamakee, Clayton, Clinton, Dubuque, Jackson, and Scott.	Upper Mississippi (see also Illinois, Minnesota, and Wisconsin).									24,441
Kentucky: Lyon and Trigg	Kentucky Woodlands							[7] 47,066	47,066	
Louisiana:										
Plaquemines and St. Bernard	Breton							[1] 25,000	25,000	955
Plaquemines	Delta		7,092	7,092	10,361		[2] 10,361		17,453	34,300
Cameron	Lacassine	58	2,574	2,632					2,632	28,720
Maine: Washington	Moosehorn		439	439				[7] 5,872	6,311	11,293

See footnotes at end of table.

TABLE 3.—*Land for refuges and related uses acquired or in process of acquisition during the fiscal year 1939 under the Migratory Bird Conservation Act, with emergency and other funds, by gifts, and by Executive order*—Continued

State and county	Refuge	Under Migratory Bird Conservation Act			With emergency and other funds			Acquired other than by purchase	Total	Acquired in previous years
		Acquired by purchase	Pending title conveyance	Total	Acquired by purchase	Pending title conveyance	Total			
		Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Maryland: Anne Arundel and Prince Georges.	Patuxent		432	432					432	2,693
Michigan: Schoolcraft	Seney	9,892	17,331	27,223	39		[2] 39		27,262	58,143
Minnesota:										
Aitkin	Rice Lake	1,423	1,550	2,973	4,731	123	[2] 4,854		7,827	3,597
Cottonwood	Talcot Lake					885	[3] 885		885	80
Becker	Tamarac	520	1,826	2,346					2,346	21,921
Houston, Wabasha, and Winona	Upper Mississippi (see also Illinois, Iowa, and Wisconsin).					1,874	[2] 1,874		1,874	14,478
Missouri:										
Stoddard and Wayne	Mingo		25,000	25,000					25,000	
Holt	Squaw Creek	1	162	163	160		[10] 160		323	6,581
Chariton	Swan Lake	1,370	1,581	2,951	18		[2] 18		2,969	7,793
Montana:										
Roosevelt and Sheridan	Medicine Lake				341	2,416	[2] 2,757		2,757	20,960
Beaverhead	Red Rock Lakes					7,209	[2] 7,209		7,209	24,965
Nebraska: Cherry	Valentine				1		[2] 1		1	65,283
Nevada:										
Humboldt and Washoe	Charles Sheldon (see also Oregon).	80	5,699	5,779					5,779	576,404
Elko and White Pine	Ruby Lake	15,729	40	15,769				[1] 7,166	22,935	12,683
New Jersey: Atlantic	Brigantine		8,000	8,000					8,000	
New Mexico:										
Chaves	Bitter Lake [5]		7,415	7,415					7,415	14,549
Socorro	Bosque del Apache		2,928	2,928					2,928	52,843
New York:										
Suffolk	Fort Tyler							[1] 14	14	
Seneca	Montezuma [5]	283	3,068	3,351				[3] 12	3,363	2,564
North Carolina:										
Hyde	Lake Mattamuskeet	219		219					219	49,925
Dare	Pea Island	2,702		2,702					2,702	3,177
North Dakota:										
Foster and Stutsman	Arrowwood				6	65	[2 3 4] 71		71	13,235
Burke and Ward	Des Lacs				282	239	[2] 521		521	13,500
Ramsey	Lake Alice		10	10					10	
Burleigh and Kidder	Long Lake		240	240					240	7,048
Burke and Mountrail	Lostwood	31	6	37	471		[2] 471		508	22,899

Bottineau and McHenry	Lower Souris	1,368	898	2,266	1,739		[2 3 4] 1,739		4,005	53,929
Renville and Ward	Upper Souris	28	680	708	160	102	[2] 262		970	30,677
Ohio: Lucas	West Sister Island							[1] 82	82	
Oklahoma: Alfalfa	Salt Plains							[1 11] 6	6	19,453
Oregon:										
Tillamook	Cape Meares							[1] 139	139	
Lake	Charles Sheldon (see also Nevada).		627	627					627	
Do	Hart Mountain		7,524	7,524					7,524	214,514
Harney	Malheur: Blitzen unit		320	320					320	65,842
South Carolina:										
Chesterfield	Carolina Sandhills							[7] 102,000	102,000	
Jasper	Savannah River (see also Georgia).	617		617					617	6,608
South Dakota:										
Brown	Sand Lake				11	320	[2] 331		331	19,465
Day	Waubay	29		29					29	2,557
Tennessee: Lake and Obion	Lake Isom					1,517	[2] 1,517		1,517	20
Texas:										
Aransas	Aransas		855	855				[1] 8,000	8,855	45,917
Bailey	Muleshoe				1,440		[2] 1,440		1,440	4,369
Utah: Box Elder	Bear River [5]	39		39					39	57,126
Vermont: Addison	Morgan Farm							[1] 952	952	
Virginia: Princess Anne	Back Bay	663		663					663	3,926
Washington:										
Stevens and Pend Oreille	Little Pend Oreille							[7] 56,600	56,600	
Spokane	Turnbull	560	3,176	3,736					3,736	7,905
Pacific	Willapa Harbor		198	198					198	2,770
Wisconsin:										
Juneau	Necedah							[7] 40,500	40,500	
Buffalo, Crawford, Grant, LaCrosse, Trempealeau, and Vernon.	Upper Mississippi (see also Illinois, Iowa, and Minnesota).					321	[9] 321		321	54,502
Wyoming:										
Teton	Elk Refuge [5]	80	620	700					700	19,877
Albany	Hutton Lake	40		40					40	1,401
Total		40,604	111,837	152,441	19,763	18,166	37,929	1,938,627	2,128,997	[12]

[1] Set aside by Executive order or proclamation.
[2] Federal Emergency Relief Administration and Resettlement Administration funds.
[3] $1,000,000 fund provided through Executive Order No. 6724, of May 28, 1934.
[4] $950,000 fund, a substitute for Executive Order No. 6724.
[5] In addition to the acreage shown, the Bureau holds 4,154.61 acres under lease on these refuges.
[6] Turned over to the Bureau by Act of Congress.
[7] Purchased by Farm Security Administration; originally intended for agricultural demonstration areas, but transferred to this Bureau.
[8] Acquired by gift.
[9] Upper Mississippi River Wildlife and Fish Refuge fund.
[10] Item in the Second Deficiency Act of 1938.
[11] Errone usly shown in report for fiscal year 1938; actually acquired by Executive order dated July 5, 1938.
[12] Total omitted, as entries in column are for only those refuges on which acquisition work was involved during the year.

NOTE.—1-acre items range from a fraction of an acre to 1.49 acres.

In addition to activities in dedicating land for wildlife refuge purposes, the year was notable for State cooperation, the legislatures of Virginia and Maryland having consented to the segregation as national sanctuaries of water areas important to migratory wild fowl. In Virginia an extensive body of water contiguous to lands heretofore acquired by the Biological Survey in Back Bay was made an inviolate sanctuary, and in Maryland action of the same nature was taken on the Susquehanna Flats, a considerable part of which will later become a Federal refuge. No other bodies of coastal waters in the United States are more important than these as concentration places for migratory game birds. Increasing land-acquisition effort must be devoted to the procurement of more or less restricted bodies of land found to be desirable for rounding out or consolidating areas heretofore brought into Government ownership. Sometimes this can be accomplished by purchase after mutually satisfactory agreements on price have been reached, but in the majority of cases, to establish an equitable compensation, recourse must be had to court proceedings.

In 27 condemnation proceedings conducted in Federal courts in 17 States, land-valuation experts of the Bureau appeared as witnesses. Probably the most noteworthy single accomplishment was the favorable outcome of the condemnation proceedings for the acquisition of lands necessary to complete the Patuxent Research Refuge, Md., thus bringing to a successful conclusion the plans of the Biological Survey for establishing a wildlife research refuge in the East.

During the year 374 miles of refuge boundary lines were surveyed, as well as 160 miles of interior or contiguous lines required by reason of lost and obliterated corners; 47 miles of level lines were surveyed and, to define refuge boundaries, 304 miles were marked. Preliminary to fence construction, 120 miles of boundary lines were staked.

Survey descriptions necessary for title examinations and preparing deeds of conveyance for 894 tracts were completed, covering approximately 251,624 acres, of which 245 tracts of 4,089 acres with irregular boundaries were surveyed preliminary to the preparation of accurate land descriptions. Topographic surveys of 160 acres were made and maps compiled therefrom. Incident to the national wildlife-refuge program, appraisals were made of 5 proposed refuges in as many States, containing a total of 36,500 acres.

RESTORATION OF WILDLIFE HABITAT BY REFUGE DEVELOPMENT

With the completion of major development work, many of the bird refuges recently established were given their first real opportunity to prove their worth, and reports from coast to coast indicate more birds on them than for many years. They are justifying the belief that they will aid materially in alleviating the serious condition of the Nation's wildlife.

Development is only beginning on some of the refuges, but on others it has reached the stage of making adjustments and repairs to refuge structures and of biological reconditioning. As in previous years, assistance was given by the C. C. C., W. P. A., and N. Y. A.

CIVILIAN CONSERVATION CORPS COOPERATION

WORK ACCOMPLISHMENTS

An average of 32 full-strength C. C. C. camps and 1 side camp was used in construction work on 32 national wildlife refuges in 24 States. Water-impoundment work, which entailed moving millions of cubic yards of earth, and construction of headquarters facilities were in the main a continuation of activities discussed in some detail in previous reports. These are here briefly reviewed, however, to show the purposes, activities, and accomplishments of the C. C. C. in 1,451 camp-months of labor during the 6 years that its facilities have been available for refuge development. The nature and significance of the operations in refuge development were popularly presented in a Bureau contribution to C. C. C. publications entitled "The C. C. C. and Wildlife."

Since the establishment of the C. C. C. in 1933 the Biological Survey has added approximately 7,760,000 acres to the national wildlife refuges. These lands compensate in small part for the millions of acres of habitat that necessarily were lost to wildlife through the plow, the ax, and the drainage ditch, but almost all the units acquired were to some extent lacking in the basic wildlife requirements of water, food, and protective cover. Forty-four of the larger and more important refuges have been, or are now being, developed and improved almost exclusively by the C. C. C.

Mentioning a few of the important details will indicate the type and quantity of the work thus far accomplished. There were 72 large impoundments and diversion dams built and 7,443,416 cubic yards of earth and rock and 238 masonry water-control structures used in the construction of levees, dikes, and jetties to reestablish marshes and impound water. Work preliminary to water impoundment included the excavation of 2,566,203 cubic yards of earth and rock from canals and ditches, as well as the clearing and cleaning of 3,422,675 square yards of water channels and 4,852 acres in reservoir, lake, and pond sites. Deficiencies in vegetation were overcome by planting immense quantities of aquatics for waterfowl, numerous shrubs and trees for upland game, and grasses for soil binding and moisture conservation, and as an erosion-control measure 674 permanent check dams were built. Nesting islands were built for the better protection of waterfowl and shorebirds. Construction work involved the erection of 56 dwellings, 21 overnight cabins, and 195 other buildings, including offices, laboratories, garages, and storage houses, and the building of 477,050 rods of fences, 1,977 miles of patrol trails, 169 foot and vehicle bridges, and fire-protection systems that included 47 lookout towers, 600 miles of telephone lines, and several hundred miles of firebreaks.

SAFETY PROGRAM

The safety of personnel is the most important consideration governing C. C. C. operations. Instruction in the importance of adhering to safe practices has resulted in improving the accident record each year, both with regard to severity and frequency. In 1937 there were 5.82 lost-time accidents per 1,000 enrollees; in 1938, 4.69; and in the current

year, only 2.78. This year, in the 1,061,932 days devoted to project work by the enrollees only 143 lost-time accidents occurred; last year there were 200. Two camps, Tule Lake Camp BF–3, Calif., and Charles Sheldon Camp BF–2, Nev., had no accidents this year, and 5 others had only 1 each.

JOB-TRAINING AND EDUCATIONAL PROGRAMS

The diversity of projects in the refuge-development program provides many opportunities for C. C. C. enrollees to learn the fundamentals of skilled trades. To construct roads, dams, bridges, and small buildings and other structural improvements necessary for efficient and economical refuge management, workers must have or acquire a knowledge of carpentry, concrete work, and operation of equipment. Throughout the 6 years of camp activity, classes in these subjects have been among the most popular of the many available to the enrollees.

On the average 269 C. C. C. employees, or approximately 85 percent of all in the Biological Survey camps, conducted on-the-job training courses, and an average of 247, or approximately 78 percent, gave classroom instruction in 76 subjects after working hours, which aggregated 211,258 hours, or an average of 6,154 per camp. Largely through the instruction given in the classrooms and on the work projects, 395 enrollees obtained private employment during the year.

COOPERATION OF WORKS PROGRESS ADMINISTRATION

The development of refuges by W. P. A. labor was continued. Allotments totaling $1,321,787 were made to the Biological Survey by transfer from the W. P. A., providing 24,655 man-months of employment for persons in need of relief. This money was expended on 84 refuges in 22 States. In addition, Bureau-sponsored State projects were approved providing for the expenditure of $955,738 of Federal W. P. A. funds, which were supplemented by the Biological Survey's contribution of $287,702; these provided 18,669 man-months of employment.

The allocation of these funds enabled the Bureau to continue water and wildlife conservation in connection with national wildlife restoration and provided worth-while projects for the employment of relief personnel. The work performed varied with the geographic position of the refuges but consisted chiefly of ditching and of building dams, dikes, and water-control structures to impound water and create marsh areas; planting aquatic and upland vegetation, shrubs, and trees used by wildlife for food and cover; constructing roads and trails, fire lanes, bridges, nesting islands, and upland-game shelters; and posting and fencing boundaries. In several cases, structures necessary for the proper maintenance and administration of refuges were erected, including residences for refuge managers, overnight cabins, boathouses, equipment sheds, barns, storage cellars for aquatic seeds and tubers, and lookout towers.

Federal W. P. A. funds totaling $93,399 were received and supplemented by the Biological Survey's contribution of $41,871 for employing statistical and clerical help to assist in bringing to date the work in the Washington office and in land-acquisition offices in Denver, Colo., and Des Moines, Iowa. About 1,250 man-months of employment were thus provided.

CORRELATION OF DRAINAGE ACTIVITIES WITH WILDLIFE INTERESTS

With the initiation a few years ago of a Federal program to aid unemployment, drainage became an eligible type of project throughout the country. The result of many ill-advised projects was unwarranted destruction of wildlife habitat by the alteration of natural water levels beyond the limits most of the desirable plant and animal forms can tolerate, in many instances eliminating indigenous plant and animal forms and permitting invasion of species that rapidly displaced the food plants of waterfowl and other marsh inhabitants.

This unnecessary destruction of wildlife habitat led to many protests by national and local conservation agencies, State conservation commissions, and private individuals against the prosecution of drainage projects in general through the use of Federal funds. These protests resulted in an understanding with the W. P. A. whereby all project applications involving drainage that were submitted to that organization were to be referred to the Biological Survey for review as to their probable effect on wildlife.

Cooperating with the W. P. A., the Biological Survey reviewed and made field inspection of 364 drainage projects (many of which were State- or county-wide in character), involving 3,294 work units. One hundred and fifty-one units that threatened to be unnecessarily detrimental to wildlife were disapproved through the Bureau's recommendations, and 955 units were recommended for partial or conditional approval, with the proviso that the plans be so modified as not to menace wildlife. In many cases, such modification resulted in the creation of new habitat to compensate for the unavoidable destruction of adjacent natural wildlife environment. The remaining 2,188 units, not involving wildlife values, were recommended for unconditional approval.

Of the 364 projects, 206 (1,812 units) were concerned with mosquito control and 158 (1,482 units) with land-utilization drainage. In the mosquito-control projects, wherever practicable, methods of larva reduction through water control and impoundment rather than by mechanical drainage were recommended and carried out in the interests of wildlife conservation.

NATIONAL YOUTH ADMINISTRATION ASSISTANCE

It would be difficult to overestimate the value of the N. Y. A. type of labor to the refuge program, especially in North Dakota. Without this assistance it would be impossible to obtain accurate data on the 68 widely scattered easement refuges on which permanent personnel is not yet maintained. Members of the N. Y. A. for the most part live on or near the refuges on which they work and serve as official observers. Not only do they supply accurate information to the Biological Survey regarding the condition of the refuges, but they also take an active interest in their upkeep and have created a better local understanding of the refuge program. They noted bird populations, recorded species that could be identified, compiled nesting data, made brood counts, and reported instances of predation and damage to structures by rodents or other mammals. They also reported weekly on the water level and weather and on the condition of buildings, dams, ditches, dikes, fences, and signs.

In addition to collecting data, these youths did some of the improvement work, including gathering seeds of desirable plants on areas where abundant to plant on areas where scarce; transplanting and caring for trees, shrubs, and aquatic plants; repairing fences and signs; and keeping ditches, dikes, and channels clear of weeds. They also regularly patrolled the refuges, and during the hunting season they acted as junior game wardens in accordance with a Statewide plan of the North Dakota Game and Fish Department, reporting immediately any law violations observed.

Work by the N. Y. A. on the Tamarac Refuge, Minn., included constructing portable boat docks and other equipment from salvaged lumber; landscaping and tree planting; building and placing 50 bird houses; taking a waterfowl census; making picnic tables, benches, boats, and concrete walks; feeding wildlife in winter; improving lawns and roads; and collecting aquatic seeds. Similar work was done on the Waubay Refuge, S. Dak., and the Nine-Pipe and Pablo Refuges, Mont.

The activities of these youths are valuable not only to the Biological Survey but also to themselves. Since this type of labor was first utilized in North Dakota in January 1937, 214 young men have been assigned to the Bureau for work on easement areas. Some of them have been employed for only a short time, but all have learned about conservation and have developed new interests that will aid them materially in later life.

ENGINEERING WORK ON REFUGES

Operating out of offices at Salt Lake City, Utah; Des Moines, Iowa; and Washington, D. C., employees of the Bureau of Agricultural Engineering supervised engineering construction on 54 refuges, the work being done in most instances by C. C. C. or W. P. A. labor. In addition, detailed plans were prepared for engineering work on numerous projects acquired or to be acquired, including, in cooperation with the Bureau of Reclamation, those for the restoration of Lower Klamath Lake, Oreg.; many topographic surveys were made; contour maps were prepared; and the engineering feasibility of a number of areas proposed for future acquisition as wildlife refuges was investigated.

Among the outstanding engineering works supervised by the Bureau of Agricultural Engineering may be mentioned the completion by the C. C. C. of the Jacks Creek dike on the Bull Island unit of the Cape Romain Refuge, S. C., begun by Army engineers; the creation of 2 pools, aggregating 3,000 acres, on Seney Refuge, Mich.; the construction of water-control works and about 17 miles of dikes on Mud Lake Refuge, Minn.; and the beginning of engineering work on the Lacassine Refuge, La., and the Aransas Refuge, Tex. One of the district engineers inspected and submitted reports on 67 easement refuges improved by W. P. A. labor in North Dakota.

One hydraulic engineer employed by the Biological Survey attended to the filing of water rights as required by various State laws and to protecting water supplies against other claimants. He also conferred with various Federal, State, and private agencies on matters relating to the use of the water on or affecting the refuges.

BIOLOGICAL DEVELOPMENT OF NATIONAL WILDLIFE REFUGES

FOOD AND COVER

Changing conditions on refuges resulting from ecological management are year by year making them more attractive to wildlife. To expedite improvement, plants high in wildlife food-and-cover values were collected and planted on refuges within their natural range. In the development of water areas more than 85,000 pounds of marsh and aquatic seeds and over 365,000 pounds of plant parts were collected on some refuges and distributed to others. Occasionally climatic and other factors combine to make available exceptional seed crops of certain desirable food plants. This year prairie bulrush produced such a crop and, as the water receded from the marginal areas, it was possible by means of a combine to collect 32,000 pounds of the seed, most of which was distributed to refuges in the Northwest.

In developing upland areas, about 2,000,000 trees, shrubs, and vines (many obtained through the cooperation of the Soil Conservation Service and the Forest Service) were planted, and more than 4,000 pounds of seeds of trees, shrubs, and vines were collected. As the Biological Survey maintains only two active nurseries, a large part of this seed was turned over to the Soil Conservation Service and the Forest Service for propagation.

Nearly 5,000 acres of refuge lands were put under cultivation for green forage and for grain production for supplementary feeding. A large part of this acreage was planted on a sharecropping basis, which relieved the refuge personnel of the tasks of cultivation and harvesting and at the same time improved local economic conditions. More than 220,000 pounds of grain were harvested and used in feeding upland game in winter and in providing food for waterfowl where natural foods were depleted.

Many areas in the West were seeded with grasses and other plants to improve range and forage conditions for wildlife, the species most widely used being crested wheatgrass, bromegrass, sweetclover, and alfalfa.

Cover-type maps, which show the natural vegetation, as well as that resulting from management, and indicate changes that will probably take place, were completed for six refuges and advanced for others, to aid in outlining their development.

NESTING AND SHELTER

As most of the forested areas on the national wildlife refuges consist of cut-over timber or second-growth stands, which are essentially lacking in the hollows used by tree-nesting ducks, more than 1,600 nesting boxes were built to resemble natural tree cavities and placed on refuges that are within the breeding range of the wood duck and the goldeneye. A close check revealed that they were being used extensively by these species and that some had been appropriated by raccoons, squirrels, and opossums.

Construction of nesting islands was continued on the waterfowl-breeding refuges, and 175 were completed. They greatly increase the available waterfowl nesting sites and, being islands, are practically free from predators. On the Malheur Refuge, Oreg., large numbers

of Canada geese and Forster's terns nested on them, and on 1 small island 171 pelican, 14 cormorant, and more than 100 gull nests were located.

The upland game-bird shelters previously constructed on refuges were found extremely valuable in maintaining game-bird concentrations during periods of severe weather, and this year 150 were added. Feed hoppers are maintained in conjunction with many of them in areas where deep snows tend to cover up natural foods.

MAINTENANCE AND OPERATION OF NATIONAL WILDLIFE REFUGES

The national wildlife refuges under the jurisdiction of the Biological Survey, with an aggregate acreage of 13,530,160, now number 260. Of these, 16 (4,094,202 acres) are in Alaska, Hawaii, and Puerto Rico. In addition 14 smaller areas (9,791 acres) are maintained for wildlife experimental and administrative purposes, on which wildlife is also protected. The nature and extent of the 260 refuges are shown in table 4.

TABLE 4.—*Nature and extent of national wildlife refuges administered by the Bureau of Biological Survey*

Character	Number	Acres
For migratory waterfowl (including easement refuges)	139	1,613,632
For other migratory birds	63	951,812
For wildlife in general (birds, mammals, and other classes)	17	4,298,128
For nongame birds chiefly	29	106,712
For big-game species	12	6,559,876
Total	260	13,530,160

The work of maintaining these refuges has increased with the establishment of new units and the completion of development of many of the older ones. Additional personnel, both permanent and temporary, was employed for general administration; for protection against trespass, vandalism, and fire; for enforcement of laws and regulations; for repair and maintenance of buildings, water-control structures, fences, towers, telephone lines, and other physical equipment; and for supervision of grazing, haying, and other farming operations; disposal of surplus big game; and public recreation.

The laws and regulations for the administration of national wildlife refuges were published in Service and Regulatory Announcement B. S. 90, copies of which may be obtained upon application to the Biological Survey. Special regulations were issued from time to time as required.

NEW REFUGES

BIRD REFUGES

The transfer to the Biological Survey of eight former Resettlement projects added about 300,000 acres to the national wildlife refuge system. One tract of about 5,500 acres was added to the Moosehorn Refuge, Maine, established primarily for the protection of woodcocks; and another of about 22,000 acres, to the St. Marks Refuge, Fla., a wintering refuge for thousands of wild geese and

for many species of ducks. The other six were established as new refuges, as follows:

Piedmont Wildlife Refuge, Ga. (about 58,400 acres), by Executive order of January 18, 1939, chiefly for the protection of bobwhite quails and wild turkeys, but also as a wildlife-demonstration area.

Kentucky Woodlands Wildlife Refuge, Ky. (48,759 acres), by Executive order of August 30, 1938, as a sanctuary for deer, turkeys, quails, waterfowl, and other wildlife.

Noxubee Wildlife Refuge, Miss. (about 40,000 acres), Executive order pending, to protect wild turkeys, raccoons, minks, muskrats, beavers, and other wildlife, and also to be a demonstration area and a station for wildlife research.

Carolina Sandhills Wildlife Refuge, S. C. (50,000 acres), by Executive order of March 17, 1939, primarily to protect quails and wild turkeys.

Little Pend Oreille Wildlife Refuge, Wash. (about 56,600 acres), by Executive order of May 2, 1939, as a sanctuary for Pend Oreille deer (probably the largest species of North American white-tailed deer), three kinds of grouse (ruffed, blue, and Franklin's), and other wildlife.

Necedah Migratory Waterfowl Refuge, Wis. (40,500 acres), by Executive order of March 14, 1939, as a refuge for ducks, geese, sandhill cranes, pinnated and sharp-tailed grouse, deer, and other wildlife.

Other important bird refuges established by Executive order included Wheeler Migratory Waterfowl Refuge, 41,800 acres, on the Wheeler Reservoir of the Tennessee Valley Authority, Ala.; Ruby Lake Migratory Waterfowl Refuge, Nev., 35,712 acres; Montezuma Migratory Bird Refuge, N. Y., 6,232 acres; and Great White Heron Refuge, Fla., 1,000 acres of land, including most of the remaining habitat of the now rare great white heron.

BIG-GAME PRESERVES AND RANGES

Two new big-game ranges were established, both in Arizona—the Cabeza Prieta Game Range of 860,000 acres, and the Kofa Game Refuge of 660,000 acres—which are being administered in cooperation with the Grazing Service of the Department of the Interior. They were established primarily to protect the Gaillard bighorn sheep, but other species also receive protection, among them the antelope, peccary, mule deer, and Gambel's quail. Negotiations are pending with the Mexican Government for the establishment of an extensive area south of the Cabeza Prieta Game Range for the protection of bighorn sheep, thus making the project international in character.

On the Kofa Game Range is protected also the fan palm (*Washingtonia arizonica*), which occurs over an area of about 80 acres in one of the most rugged sections of the Kofa Mountains and is not found elsewhere in the world. It grows in deep canyons in sand accumulated in the pot holes worn by waterfalls, and attains a height of 10 to 30 feet.

CONDITIONS ON BIRD REFUGES

INCREASED USE BY BIRDS

References to conditions on a few of the more than 200 bird refuges will indicate the increasing value of the national system for

wildlife conservation and restoration. Various refuges shared in the developmental work already discussed and were thus made increasingly attractive to species for which established. The large increases in the number of birds using some of the refuges may be attributed chiefly to greater stabilization of water levels, improvement of habitat as a result of planting operations and restricted or prohibited grazing, control of predators, and more adequate protection.

Swan Lake Refuge, Mo.—Ducks stopped during the fall migration in larger number than for many years, and thousands of mallards, pintails, teals, baldpates, gadwalls, scaups, and ring-necked ducks concentrated on the refuge, many remaining until January 15.

Waubay Refuge, S. Dak.—In addition to at least 100,000 ducks, a flock of whistling swans and hundreds of geese, mostly white-fronted and Canada, but also several large flocks of blue and snow geese, stopped on this refuge during the fall migration, the first time since the refuge was established that the latter two species of geese have stopped in any numbers in fall and that the swans have appeared.

Valentine Refuge, Nebr.—The fall flight of the sandhill cranes in the vicinity of this refuge was the largest in years, and for the first time a few alighted—usually they fly high and pass over without stopping. The flight of Franklin's gulls also was exceptionally large, and it was estimated that on 1 day in October there were about 30,000 on 2 of the lakes.

Sacramento Refuge, Calif.—During the latter part of November, 1,150,000 pintails, 50,000 mallards, and numerous other waterfowl, including 5 species of geese, were on this refuge. At least three times as many mallards nested in 1939 as in 1938, and there was a large increase in the number of nesting black-necked stilts. A few shovelers and Forster's terns bred for the first time.

Bitter Lakes Refuge, N. Mex.—Among the 300,000 wintering waterfowl, mallards were the most numerous, followed by pintails, baldpates, shovelers, and gadwalls. In the latter part of January, there were at least three times as many waterfowl on the refuge as in the corresponding period in 1938.

Bombay Hook Refuge, Del.—Willets, which nested on the refuge for the first time in 1938, bred again this year—39 pairs—and the number of nesting shovelers increased to 18 pairs. The 1 brood of coots raised provided the southernmost nesting record of this species on the east coast. A ring-necked duck was seen in the spring, an American goldeneye remained from December 9 to March 6, and a pair of gadwalls nested and reared its brood in the tidal salt marsh in the summer of 1939—3 new records for the refuge. On April 13 a black vulture was identified, one of the few records of this bird in the State.

Nine-Pipe, Pablo, and Pishkun Refuges, Mont.—For the first time in many years willets stopped in the fall on these three refuges, marbled godwits on Nine-Pipe, sharp-tailed grouse on Pishkun, and upland plovers on Pablo. During the 1939 spring migration, Holboell's and pied-billed grebes and ring-necked ducks occurred for the first time on Nine-Pipe and Pablo, white-fronted geese on Nine-Pipe, and wood ducks on Pishkun.

Lower Souris Refuge, N. Dak.—Geese, mostly blue and snow, but also a few Hutchins', Canada, and white-fronted, use this refuge in

increasing numbers each year. During the spring flight at least 15,000 stopped, as compared with 2,000 in 1938. It was estimated that 67,000 ducks were on the refuge in May, as compared with 26,060 the previous year. Redheads and canvasbacks showed outstanding gains.

Des Lacs Refuge, N. Dak.—The number of breeding ducks increased from 5,000 in 1938 to 21,000 this year, and a large hatch was expected. Increases were also noted in western, eared, and pied-billed grebes, coots, rails, bitterns, and black terns. Species seen on the refuge for the first time included the European wigeon, western harlequin duck, and surf scoter. For the first time since the refuge was established, all but one of its water units were filled to capacity.

Tule Lake Refuge, Calif.—In January, when the annual waterfowl census was taken, there were 20,533 ducks, 3,233 geese, and 366 whistling swans, a total of 24,132 waterfowl, on this refuge, more than twice the estimated number for the corresponding period in 1938. The number of waterfowl present during both spring and fall migrations showed a marked increase, canvasbacks in particular.

Sand Lake Refuge, S. Dak.—More than 20,000 nests of Franklin's gull were found, as compared with 6,100 in 1938 and about 6,000 in 1937, the first year this species nested on the refuge. Ruddy ducks and redheads also showed substantial increases over previous years.

Malheur Refuge, Oreg.—The number of waterfowl has been steadily increasing, and it was estimated that in the fall there were a million water birds on the refuge. The annual census in January 1939 revealed almost 12,000 wintering ducks, a vastly increased number over 1938.

Cape Romain Refuge, S. C.—The number of lesser scaups wintering on this waterfowl refuge increased from 5,000 in 1938 to 15,000 this year. Other waterfowl remained in about the same numbers as in previous years or showed a slight decrease. More birds were noted during the hunting season than at any other time, more than 80,000 having been counted.

Bear River Refuge, Utah.—More waterfowl were on the Bear River marshes during the fall migration than in any year since the establishment of the refuge; it was estimated that there were at least 2,000,000 ducks at the peak of the migration.

Lacassine Refuge, La.—On this migratory-waterfowl refuge, which has been under administration for 1 year, the January waterfowl census showed more than 50,000 wintering ducks and thousands of other birds. During migration, geese, pied-billed grebes, lesser scaup ducks, black-necked stilts, Wilson's snipes, and sandpipers visited the refuge. A large number of nesting herons began laying eggs on April 1, and the young birds were completely feathered and nearly grown by June 13.

EASEMENT REFUGES

Only 3 new easement refuges were added, all in South Dakota, namely, the Lake Arconge, 240 acres; Eagle Creek, 1,201 acres; and Quinn Lake, 480 acres. Executive orders establishing 40 North Dakota easement refuges were issued. There are now 81 easement refuges, totaling 135,378 acres, of which 68 (109,924 acres) are in North Dakota (3 North Dakota projects were dropped or combined

with others); 8 (22,931 acres) in Montana; and 5 (2,523 acres) in South Dakota. In South Dakota, easements were also obtained covering important additions to 2 existing refuges—the Lake Andes and Lacreek.

In the spring all the North Dakota easement refuges received a good supply of water: the impoundments on 33 reached spillway level, 12 were three-fourths full, 11 were at the halfway mark, 8 had enough water to take care of the birds hatched, and only 4 had insufficient water. All are in better condition than ever before. The Montana refuges that were near enough completion to impound water also received a plentiful supply.

During the spring migration, outstanding concentrations occurred on several of the North Dakota refuges. It was estimated that there were at least 500,000 geese in the vicinity of Lac Aux Mortes, Snyder, Brumba, and Rock Lake Refuges, near Devils Lake, surpassing in numbers the goose flight of 1938, reported the largest for many years. The Ardoch Lake Refuge also had a large concentration of geese, variously estimated at 30,000 to 50,000. Lakes Tewaukan, Ardoch, and Elsie were the nightly resting places for huge flocks of Franklin's gulls during the fall migration, the Lake Tewaukan nightly concentration totaling from 250,000 to 750,000 for almost a month. In October about 10,000 pelicans concentrated on the Dakota Lake Refuge. There was a small decline in the number of ducks nesting on the easement refuges and also in the number stopping during spring migration. The Chase Lake Refuge had about 5,000 breeding ring-billed and California gulls, and the Long Lake Refuge a large colony of Franklin's gulls, estimated at 20,000 nests.

Large numbers of waterfowl and shorebirds used the Lake Thidadeau, Black Coulee, and Hewitt Lake Refuges, Mont., for feeding and resting, and several thousand nested on them. Thousands of ducks, coots, grebes, gulls, and shorebirds also bred on the small Greedmans Coulee Refuge, which was completed only this year. The other Montana projects either are still under construction or were finished too late in the season to be much used.

In South Dakota only the Lake Andes Refuge was near enough completion to attract many birds, but thousands of waterfowl and shorebirds nested or fed there during migration.

Since there was little acquisition activity on easement refuges, attention was directed principally to completing construction and improvement work and to biological reconditioning. During the year the W. P. A. funds expended on the North Dakota easement refuges totaled $114,060, providing about 1,800 man-months of employment; on the Montana refuges, about $98,700, providing 1,853 man-months; and in South Dakota, about $32,500. The major operations included the building of control works; constructing and graveling roads; placing additional riprap to protect various structures; building nesting islands and bridges; drilling wells; repairing dams, ditches, spillways, fences, and signs; planting trees and aquatics; and constructing recreational facilities.

CONDITIONS ON GAME PRESERVES

The numbers of big-game animals on the Bureau's fenced preserves are given in table 5.

TABLE 5.—*Animals on fenced big-game preserves maintained by the Bureau of Biological Survey (estimated)*

ANIMALS AS OF JUNE 30, 1939

Preserve	Buffalo	Elk	Antelope	Bighorn sheep	Deer		Texas longhorn	Total
					Whitetailed	Mule		
National Bison Range, Mont.	428	40	------	54	47	161	------	730
Fort Niobrara Game Preserve, Nebr.	156	39	------	------	7	5	18	225
Sullys Hill Game Preserve, N. Dak.	22	31	------	------	15	------	------	68
Wichita Mountains Wildlife Refuge, Okla.	420	202	15	------	759	------	149	1,545
Total	1,026	312	15	54	828	166	167	2,568
YOUNG BORN IN CALENDAR YEAR 1938								
National Bison Range, Mont.	69	12	------	13	5	52	------	151
Fort Niobrara Game Preserve, Nebr.	31	11	------	------	------	------	4	46
Sullys Hill Game Preserve, N. Dak.	7	8	------	------	4	------	------	19
Wichita Mountains Wildlife Refuge, Okla.	74	25	6	------	100	------	22	227
Total	181	56	6	13	109	52	26	443

Charles Sheldon Refuge, Nev.—Following ample snow and rain on this antelope refuge and range, grass and forage made an exceptionally fine growth in the summer of 1938, but as there was not much precipitation during the following winter, the grass started drying early in May. No stock is permitted to graze on the winter range of the antelope, however, so there will be ample winter forage for all the wildlife there. The antelope returned to their summer range in fine condition. At the beginning of the year, 2,500 were estimated to be on the refuge, but when winter storms set in, driving the animals to their winter range, the number increased to about 5,000. Mule deer, definitely on the increase, were estimated at 2,000 at least, and the band of wild horses at between 250 and 300. An increase in the number of ducks and geese also was noted.

Fort Niobrara Preserve, Nebr.—A good hay crop was in prospect on this preserve, and though part of that harvested by sharecroppers last fall was used for the winter feeding of buffalo, much still remains for next winter. In addition to the big-game animals listed in table 5, numerous birds use this preserve, and this year prairie chickens, pheasants, quails, and grouse were seen and 500 ducks remained all winter. The small trees and shrubs planted around the headquarters building attracted many insectivorous birds, also.

Hart Mountain Refuge, Oreg.—Plentiful rainfall early in 1938 resulted in greatly improved range conditions on this refuge, but spring precipitation was deficient in 1939. Big-game counts showed 2,000 antelopes on the refuge and about 1,400 on adjacent areas and, in the latter part of December, 2,011 mule deer. A definite increase in the number of sage grouse was shown by the fact that on an area where 47 were counted in 1937, there were 440 this year. A slight increase in Hungarian partridges also was observed. As the year closed Miscellaneous Publication 355, describing this refuge, was in press.

Desert Game Range, Nev.—Despite little spring rainfall, this game range, which has been greatly overgrazed in the past, is improving,

owing to the curtailment of many grazing permits. It was estimated that 300 bighorn sheep were on the range at the close of the year, about 23 percent of which were lambs.

Sullys Hill Preserve, N. Dak.—About 12 acres of trees were cut by W. P. A. labor last winter on this preserve to provide a growth of sprouts and shrubs for deer and elk browsing, 7 acres of which were fenced to keep animals out and allow the plants to get a few years' growth. A good stand of grass provided excellent grazing for the animals. The refuge is much used by birds also. About 2,000 ducks stopped on the lake in the fall and 1,000 in the spring, but few nested, as the lake is surrounded by trees and does not provide good nesting cover.

Wichita Mountains Refuge, Okla.—Lake levels were too low this year for recreational purposes, but there was ample water for the big game and other wildlife. Approximately 450 wild turkeys were counted during the winter. Bobwhites and doves were present in fair numbers, the former appearing to have become reestablished after being rare for many years, but prairie chickens were scarce, 18 being the largest number counted at any one time.

Elk Refuge, Wyo.—Owing to considerable rainfall in Jackson Hole last year and a favorable growing season, natural forage was excellent on the pasture and range lands of the refuge and elk herds fared well on it until the latter part of February, when a 33-day feeding period began, during which about 18,665 bales, or 849 tons, of hay were fed and 143 tons of loose hay. A total of 37,100 bales was harvested in the summer and early fall of 1938, and the crop on 780 acres was left standing as elk pasturage. About 8,000 elk were fed on the refuge during the winter, 1,800 more than in the previous year, and about 1,000 wintered in the nearby foothills and along the Gros Ventre River. Though more elk were on the refuge, the number in the Jackson Hole herd remained about the same as in the spring of 1938, when 17,370 were counted. The mule deer seen numbered 32, and the moose 7. More waterfowl were present during the fall migration than for many years, the increase in Canada geese being at least 50 percent. Nesting species included the sandhill crane and several ducks. Three of the four trumpeter swans that were transferred to the refuge from the Red Rock Lakes Refuge, Mont., last winter were seen daily less than a mile from headquarters.

National Bison Range, Mont.—Forage conditions on this range were such that winter feeding of the buffaloes was not necessary, though some hay was put out for the deer during periods of heavy snow. Late in February and early in March approximately 3½ acres each of blue grama and little bluestem grass and 43 acres of crested wheatgrass were sown as an experiment in range revegetation. In cooperation with the University Forestry School at Missoula, test plots of mountain brome, sand dropseed, mountain rice, and native bunch grass also were planted. Ducks and geese were plentiful on the refuge both in spring and fall, and during the local hunting season hundreds of pheasants came to the refuge and many remained.

ECONOMIC USES OF REFUGES

Permits to the number of 730 were issued for numerous economic and special uses of wildlife-refuge lands, chief of which were hay

and timber cutting and livestock grazing. On about 29,475 acres of refuge lands 157 permits were issued for cutting 11,190 tons of various kinds of hay. Grazing permits numbered 117, authorizing approximately 117,350 animal-months' use by about 17,150 cattle, 12,250 sheep, 300 horses, and 75 hogs, chiefly on the following refuges: Valentine, Nebr.; Aransas, Tex.; Malheur, Oreg.; Bosque del Apache, N. Mex.; and Hart Mountain, Oreg., which provided grazing. Although only about 1,800 cords of timber were cut, this use provided much-needed wood for 164 permittees, most of whom were individuals living in the immediate vicinity and requiring fuel wood for personal use only.

Another major economic use of the refuges was the cooperative farming of approximately 32,350 acres. For this purpose 172 permits were issued to persons who agreed to raise various farm crops and hay for the big-game animals on the refuges.

For miscellaneous uses, 120 permits were issued, authorizing ice cutting; erection, maintenance, and use of buildings and of telephone and power lines; placing stands of bees; picking fruit in orchards; and opening and maintaining stock driveways or lanes for watering cattle.

To keep the herds of big game at a level where they will not overgraze their ranges, it is necessary each year to dispose of surplus animals. Whenever possible, these are donated to city and State parks and zoos for exhibition purposes; but some are sold or given to various Federal, State, and private agencies for butchering. This year 55 buffaloes, 4 deer, and 29 elk were disposed of. Of the buffaloes, 33 were sold for butchering, 13 were donated for exhibition purposes, and 9 were given to Indian agencies for food. The 4 deer, accidentally killed, were given to a charity organization. Of the 29 elk, 18 were donated for exhibition purposes, 6 were sold, 2, accidentally killed, were given to charity, and 3 were given to an Indian agency.

The total revenue received from the sale of surplus big-game animals and other refuge products and for the use of refuge lands was $45,213.52. In accordance with the law, 25 percent of the total is turned over to the counties in which the refuges are situated and the remainder is deposited in the Federal Treasury.

RECREATIONAL USES

In addition to their agency in increasing the wildlife population, the refuges have other public values. Many of them provide the only recreational facilities within a radius of many miles, and where it has been found that controlled use for public enjoyment will not unduly interfere with the wildlife, fishing, swimming, boating, camping, picnicking, sightseeing, and other recreational uses are permitted to some extent. Hunting during the open season is permitted on specified parts of only six refuges—Tule Lake, Calif.; Bear River, Utah; Red Rock Lakes, Mont.; Lake Bowdoin, Mont.; Upper Mississippi, Iowa, Ill., Minn., and Wis.; and Mattamuskeet, N. C.

Orders designating areas on which fishing is permitted were issued for the following refuges: Savannah River, Ga. and S. C.; Tamarac and Rice Lake, Minn.; Big Lake, Ark.; Kentucky Woodlands, Ky.; Elk Refuge, Wyo.; Seney, Mich.; Lower Souris, N. Dak.; and Wich-

ita Mountains, Okla. On the Okefenokee Refuge, Ga., under permits issued for 5,319 man-days of fishing, 47,223 fishes were taken. In 4 months, 10,138 fishermen took 67,239 fishes from the waters of the Chautauqua Refuge, Ill. Permits were issued to 693 persons in 1 month to fish on the Mattamuskeet Refuge, N. C. On the opening day of the fishing season, 8,000 persons fished on the Wichita Mountains Refuge, Okla., which supplies some of the best fishing in that State.

Picnic facilities, consisting usually of shelters, tables and benches, outdoor ovens, and toilets, have been constructed on many refuges. Thousands of persons annually visit some of the refuges to view the wildlife, and this year exhibition herds of buffalo, elk, and deer on small Sullys Hill Game Preserve, N. Dak., attracted 22,383 visitors.

WILDLIFE-CONSERVATION LAWS ADMINISTERED

The principal Federal statutes administered by the Biological Survey for the conservation and restoration of wildlife are (1) the Lacey Act of 1900, as amended June 15, 1935, and June 19, 1939, regulating shipments in interstate and foreign commerce of wild animals, their dead bodies, or parts thereof, and the importation of live birds and mammals from foreign countries; (2) the Migratory Bird Treaty Act of 1918, protecting birds that migrate between the United States and Canada, as amended June 20, 1936, to extend its provisions to the treaty concluded March 15, 1937, protecting birds that migrate between the United States and Mexico, and regulating the movement of game mammals and parts thereof between the two countries; (3) the Migratory Bird Conservation Act of 1929, authorizing the establishment of bird refuges; (4) the Migratory Bird Hunting Stamp Act of 1934, as amended June 15, 1935, to aid in refuge establishment; (5) the Federal Aid to Wildlife Restoration Act of 1937; (6) a law (sec. 84, Criminal Code) protecting wildlife and property on national wildlife refuges; and (7), through the Alaska Game Commission, the Alaska Game Law of 1925, as amended June 25, 1938.

REGULATORY ACTION

The Migratory Bird Treaty Act regulations were amended in 1938 to provide an open season of 45 consecutive shooting days on migratory waterfowl, coot, and Wilson's snipe, in each of 3 zones, beginning in the northern zone on October 1, in the intermediate zone on October 15, and in the southern zone on November 15. Full protection was continued on the wood duck, Ross' goose, and swans throughout the country, and on the snow goose and brant in States bordering on the Atlantic Ocean. A limit of 3 of any one or 3 in the aggregate, of canvasbacks, redheads, buffleheads, and ruddy ducks was permitted in the daily bag limit of 10 ducks of all kinds.

The restrictions on taking waterfowl by means of bait or by the use of live decoys, and the three-shell limit on repeating shotguns, remained in effect. The hours for shooting waterfowl and coots were from 7 a. m. to 4 p. m.; for taking Wilson's snipes, rails, and gallinules (other than coots), woodcocks, mourning doves, white-winged doves, and band-tailed pigeons, from 7 a. m. to sunset. The posses-

sion limit was raised to not more than 2 days' bag limits of ducks and geese, including brants, but remained the same as a daily bag limit on all other migratory game birds, as follows: Rails and gallinules (except soras and coots), 15 in the aggregate of all kinds; soras, 15; coots, 25; Wilson's snipes, 15; woodcocks, 4; and mourning doves and white-winged doves, 15 in the aggregate of both kinds. Band-tailed pigeons remained in their previous status, with a maximum bag of 10. The regulation governing interstate shipment of migratory game birds was amended to permit shipping the possession limit in 1 calendar week out of the State where taken or from Canada or Mexico into the United States.

The regulations for 1938 were published in Service and Regulatory Announcement B. S. 92; the open-season dates and other information regarding hunting, in poster form (61–Bi). Other publications relating to conservation laws included a mimeographed abstract of State fur laws affecting trapping seasons, possession, and the sale and shipment of pelts (Leaflet BS–118) and Miscellaneous Publication 329, the annual directory of Federal, State, and Canadian game-protection officials. Many press and radio statements on wildlife-conservation subjects also were released for educational purposes and to advise the public of the results of law enforcement as well as of changes in the regulations. Amendments to the regulations under the Alaska Game Law were published in Circular 17 of the Alaska Game Commission.

Representatives of the State game departments again met with officials of the Bureau to discuss conditions affecting the conservation and hunting of migratory game birds and their pursuit by hunters. Their recommendations were a great aid in drafting the hunting regulations for the 1939 season.[3]

WORK OF GAME-MANAGEMENT AGENTS

Working under central direction and the general supervision of regional directors, 42 game-management agents and 13 deputy agents gathered information in cooperation with State officers and deputy game wardens, supplemented evidence, or themselves furnished all the evidence in 2,560 cases of game-law violation prosecuted in State and Federal courts, resulting in 2,444 convictions. In educational work to further game protection, the agents conducted programs by radio and motion pictures, spoke before schools, civic associations, and sportsmen's clubs, and issued statements through the press. They also worked with farm groups to control birds that were damaging crops. Each spring and summer the agents have inspected nesting areas in their districts to determine the relative abundance of wild fowl. They are looked to by State conservation agencies, sportsmen, nature students, and citizens interested in wildlife for leadership in the enforcement of laws for wildlife conservation. The varied lines of work and responsibilities of Federal personnel engaged in game-law enforcement were set forth in detail in a leaflet (BS–135) issued in May.

[3] Regulations for 1939 were adopted by the Secretary of the Interior on August 3, 1939, and were approved and proclaimed by the President on August 11, 1939 (4 F. R. 3621 DI).

APPREHENSION OF VIOLATORS

The enforcement activities of the game-management agents are exemplified in the following apprehensions:

In Ohio, 9 persons apprehended were convicted in Federal court for violating and conspiring to violate the Migratory Bird Treaty Act by hunting wild ducks by aid of feed and live decoys. One was fined $1,500, received a sentence of 1 year and a day in jail (suspended upon payment of fine), and placed on probation for 5 years. The others paid fines aggregating $525. In addition, 4 were given suspended jail sentences of 6 months each and placed on probation for 5 years and 2 each were placed on probation for 1 year.

In Kentucky, 37 persons accused of hunting mourning doves over baited ground were convicted in Federal court, and each was fined $50 and $20 costs, but payment of the fine was suspended in 3 cases.

In Virginia, a defendant charged with killing 2 American egrets was fined $250 in Federal court.

In Michigan, a person accused of hunting coots and wild ducks from a motorboat was sentenced to serve 6 months at the Federal Detention Farm at Milan.

In Arizona, of 5 persons apprehended in possession of 207 white-winged doves and 43 mourning doves, 1 was sentenced to pay a fine of $50 and to serve 60 days in jail, 2 to pay fines of $100 each, and 2 to pay fines of $50 each.

In Maryland, 2 persons arrested for killing mourning doves by aid of feed were fined $100 and costs of $31 each.

In Louisiana, for selling wild ducks, 2 defendants were each sentenced to 60 days in jail; for hunting ducks over live decoys, 1 was sentenced to 30 days and 1 to 60 days in jail; for hunting ducks after 4 p. m., with an unplugged gun, and for threatening to shoot an agent of the Survey and a State conservation agent, 2 each received a jail sentence of 1 year.

In a drive to break up the commercializing of game in California, 12 persons were apprehended for selling wild ducks and geese. Ten convictions were obtained in Federal court, resulting in fines aggregating $750 and the imposition of jail sentences of 3 months for 2 persons and 4 months for 1.

In Missouri, 2 culprits convicted of possessing and selling finches and buntings as cage birds were fined $60 and $30, respectively.

In Massachusetts, for possessing ducks in closed season and for selling ducks, 2 persons each received a suspended jail sentence of 4 months and were placed on probation for 2 years.

Of the 861 new cases filed in the Federal courts, 620 were disposed of with 504 convictions. That more than 81 percent of the 620 prosecutions resulted in convictions indicates that the agents are not making useless arrests or prosecutions. The same percentage was achieved also in the preceding year.

A summary of the year's prosecutions is given in table 6.

TABLE 6.—*Summary of prosecutions of game-law violations, fiscal year 1939*

Act	Convictions	Fines and costs	Jail sentences
	Number	*Dollars*	*Days*
Migratory Bird Treaty Act	648	20,648.63	2,585
Migratory Bird Conservation Act	15	215.00	300
Migratory Bird Hunting Stamp Act	87	609.42	90
Wildlife Refuge Trespass Act	16	221.00	----------
Upper Mississippi River Wildlife and Fish Refuge Act	11	230.55	----------
Lacey Act	19	1,757.71	210
State prosecutions resulting from Lacey Act investigations	147	5,480.19	----------
State laws, cooperative prosecutions	1,501	42,122.06	1,199
Total	[1] 2,444	71,284.36	4,384

[1] In 116 other cases the defendants were found not guilty or the cases were dismissed, bringing the total cases to 2,560.

UNDERCOVER OPERATIONS

In making appropriations for the protection of migratory birds, Congress authorized the expenditure of not to exceed $10,000 in the discretion of the Secretary for the purpose of obtaining information concerning violations of the Federal game laws. This action opened a new avenue of attack against commercialism in waterfowl. Lateness in promulgating regulations resulted in the expenditure of only $2,393.68 for confidential undercover operations, but the evidence and information acquired were presented in courts against 105 defendants. These were assessed fines of $4,500 and costs of $780.50, with $200 in fines suspended; in addition, sentences of 740 days in jail were imposed; sentences of 90 days in jail were suspended; imposition of sentences was suspended for 3 years in each of 8 cases; and an aggregate of 7 years' probation was imposed in each of 3.

MIGRATORY BIRD TREATY ACT CASES

There was an increase over the preceding year of 192 Migratory Bird Treaty Act cases reported for Federal prosecution; an increase in convictions obtained; and an increase in cases terminated. Fines ranging from $1 to $1,500 and costs aggregating $20,648.63 were imposed in Federal courts; and in 12 cases, fines aggregating $526 were suspended. Jail sentences aggregating 2,585 days were assessed as follows: 5 days, 3 cases; 10 days, 2; 20 days, 1; 30 days, 14; 60 days, 10; 90 days, 4; 120 days, 2; 6 months, 1; 1 year, 2. Suspended jail sentences: 6 months, 4; 1 year and 1 day, 1. Probation terms: 6 months, 5; 1 year, 10; 18 months, 8; 2 years, 11; 3 years, 2; 5 years, 8.

MIGRATORY BIRD CONSERVATION ACT CASES

For violations of the Migratory Bird Conservation Act, 30 new cases were submitted and 4 were pending from the previous year; of these 18 were closed as follows: $5 fine, 1 case; $10 fine, 1; $200 fine, 1; 30 days in jail, 1; 60 days in jail 3; 90 days in jail, 1; 1 day probation, 3; 6 months' probation, 3; 1 year probation, 1; dismissed, 1; closed without prosecution, 2. Cases pending, 16.

MIGRATORY BIRD HUNTING STAMP ACT CASES

New cases submitted for violations of the Migratory Bird Hunting Stamp Act totaled 88; cases pending from the year previous, 45. Of these, 87 were successfully concluded, the fines ranging from $1 to $25, which with costs aggregated $609.42. Sentences were as follows: 30 days in jail, 3 instances; 30 days in jail suspended, 3; 1 year probation, 1. Other cases were disposed of as follows: Dismissed, 12; closed without prosecution, 1; nol-prossed, 1; jury trial, not guilty, 1; grand jury, no true bill, 2. Cases still pending, 30. It is significant of increased law observance that the sales of the $1 migratory-bird hunting stamps increased from $783,039 in 1938 to $1,002,715 in 1939.

WILDLIFE REFUGE TRESPASS ACT CASES

Under the law protecting wildlife and Government property on national wildlife refuges, 11 new cases were reported and 21 were pending from the previous year. Of these, 16 were closed by fines aggregating $221; in 6, defendants were placed on probation for an aggregate of 8 years; 4 were dismissed; and in 1, a jury returned a verdict of not guilty. Cases still pending, 5.

UPPER MISSISSIPPI RIVER REFUGE CASES

Of 8 cases pending from the preceding year and 26 new cases reported for prosecution, 14 were closed as follows: In 11, fines and costs aggregating $230.35, suspended jail sentences of 40 months, and probations of 6 years were imposed; 2 were dismissed; and 1 was closed without prosecution. Cases pending, 20.

LACEY ACT CASES

For illegal interstate shipment of wild animals or parts thereof, 18 new cases were reported for prosecution in Federal courts and 4 were pending from the year previous. The new cases were disposed of as follows: In Tennessee, 10 persons paid fines and costs amounting to $585.21 for transporting 1,222 dead bobwhites from Mississippi; in New Mexico, 1 was fined $500 and sentenced to 90 days in jail for shipping out a beaver pelt; in Wisconsin, 2 were fined $200 and $100 respectively for shipping beaver and other furs to Minnesota; in California, 1 was sentenced to 120 days in jail for shipping beaver pelts to Washington and 1 was fined $250 for shipping elk carcasses from Montana; in Texas, 2 were each fined $25 for receiving parts of deer shipped from New Mexico; and in Michigan, 1 was placed on probation for 3 years for shipment of beaver pelts to Ohio. Of the 4 pending cases, 2 were undisposed of, 1 was dismissed, and 1 resulted in a fine of $50 and costs of $22.50 for purchasing furs illegally shipped from Iowa to Nebraska.

Agents making inspections under this statute at fur-receiving centers in 18 States discovered information relating to possible infractions of State game laws. Invoices relating to 1,816 shipments of pelts were sent to game-protection officials in 35 States, Alaska, and Canada and disclosed 147 law violations that were terminated in State courts by fines and costs aggregating $5,480.19.

OTHER COOPERATION WITH STATES

Evidence regarding 1,501 cases involving violations other than illegal interstate shipment of skins of fur animals was handled in 43 States, where fines and costs aggregated $42,122.06 and jail sentences in 36 cases totaled 1,199 days. Special investigations by State wardens and Biological Survey agents working together broke up many commercial rings operating unlawfully in furs and game. Coordinated patrols were effective in developing a more wholesome respect for, and a more general observance of, conservation laws. Bureau officers participated as instructors in game-warden schools in several States. In some instances the States and the Bureau employed enforcement officers and operated patrol boats jointly. Such cooperation assures increased protection of wildlife.

COURT ACTION ON BAITING CASE

In a case involving the hunting of mourning doves by means of feed, in which the issue was whether averment and proof of knowledge of baiting is necessary to constitute a cognizable offense under the Migratory Bird Treaty Act and the regulations thereunder, Judge John D. Martin, Sr., in the United States Court for the Western District of Tennessee, on June 13 overruled both the demurrer of the defendant and his motion to quash the information, in the following terms:

> Nowhere in the statute, or in the regulations promulgated pursuant thereto, will be found, either in express language or by necessary implication, any requirement of averment or proof of *knowledge* to constitute a punishable violation of the statutory offense charged. * * *
>
> The fact that the penalty provided is within the discretion of the trial judge a fine, or an imprisonment, or both, affords adequate protection to an offender unconscious of law violation against punishment more excessive than would be commensurate with the degree of guilt. Conviction does not necessarily mean imprisonment. No minimum fine is even required. A nominal, or a small fine may be imposed upon a technical violator, innocent of guilty intent. If justice demands it, the conscious law violator, or the repeater, may be imprisoned within the limits of the statute. Congress has not placed an unintentional law violator in unjust jeopardy of arbitrarily fixed punishment, but

has confided to the courts the duty and discretion of making the punishment fit the crime. * * *

The conclusion has been reached that, in the instant case, it is unnecessary for the Government either to aver in the information, or to prove at the trial, that the defendant had knowledge of the unlawful baiting of the hunting ground, in order to render him amenable to punishment for a violation of the statute and the regulations promulgated pursuant thereto by the Secretary of Agriculture.

IMPORTATION AND OTHER PERMITS ISSUED

SPECIES EXCLUDED

The Biological Survey prevented on several occasions attempted importations of common mynas, bullfinches, chaffinches, and greenfinches, the entry of which is prohibited by joint action of the Secretary of Agriculture and the Secretary of the Treasury. No attempts to import mongooses or other prohibited mammals were reported. Since the passage of the Lacey Act on May 25, 1900, pursuant to which the regulations were adopted, no forbidden species of bird or mammal has established a foothold in the United States.

Applications continued to be received for permits to import, usually from Mexico and the Tropics, mockingbirds, grosbeaks, American goldfinches, indigo and painted buntings, and other migratory birds, but all such applications were rejected. On several occasions the Bureau's inspectors intercepted in miscellaneous shipments species of migratory birds that were referred to in applications for permits as canaries or other species of finches that may be lawfully imported. When migratory birds are detected in such cases, they are confiscated and donated to public zoological parks for scientific or educational purposes. By close supervision in this respect, migratory birds of species native to the United States are being excluded from the traffic in imported cage birds.

SPECIES ENTERED UNDER PERMIT

Including 20 at Honolulu, Hawaii, 1,791 permits were issued for the importation of foreign birds and mammals, and 440 importations were inspected.

BIRDS

A total of 252,628 foreign birds were imported into continental United States, as compared with 270,000 last year. They included 121,024 canaries, 2,799 parrots, 87,457 Mexican quails, 14,510 Hungarian partridges, 396 pheasants, and 26,442 miscellaneous birds, decreases being especially notable in canaries and parrots. At Honolulu, 492 foreign birds were entered, as compared with 1,090 last year.

Several large shipments of Hungarian partridges were again brought in from Europe during January and February by authorities in Pennsylvania, although the total number was slightly less than last year, and about 540 individuals were imported from Canada.

By order of August 19, 1938, of the Secretary of the Treasury and the Secretary of Agriculture, the joint regulations of November 21, 1927, and all amendments thereof, governing the importation of bobwhite quails from Mexico were revoked, effective September 1. This

revocation resulted in the elimination of health inspection of quails at the border, a requirement that was found to have survived its necessity, but provision was continued for the issuance of special permits by the Secretary of Agriculture for the importation of such birds, as required by section 241 of the Penal Code. As a consequence, importation permits were issued direct from the Washington office during the past season instead of at Texas ports of entry, but only to applicants or their agents who had previously obtained export permits from the Mexican Government. The latest season prescribed by Mexico for the capture of bobwhite quails extended from December 1, 1938, to March 31, 1939, but the first shipment of these birds did not arrive in the United States until January 10, when 50 were entered. Thereafter in the month, and during February and March, they continued to come in steadily in larger consignments through ports in Texas. The total number imported was 87,457, compared with 79,465 last year, of which 4,594 were entered at Brownsville, 39,346 at Laredo, and 43,517 at Eagle Pass, Tex. Of those entered at Eagle Pass, 2,782 are reported to have died in the warehouses of the importer and, because of poor condition, 269 were liberated. The rest were distributed as follows: Indiana, 21,412; Texas, 21,325; Mississippi, 15,650; Kentucky, 12,571; West Virginia, 3,550; Florida, 3,192; Oklahoma, 1,225; South Carolina, 1,150; North Carolina, 710; Pennsylvania, 490; District of Columbia, 425; New York, 415; Illinois, 350; Delaware, 250; Tennessee, 200; Hawaii, 200; Massachusetts, 186; Missouri, 175; Alabama, 173; Louisiana, 100; and several other States, several small shipments of less than 100 each.

Among the more interesting pheasants imported were 17 of 5 species as follows: 2 Horsfield pheasants (*Gennaeus horsfieldii*), from Italy; 4 Blyth's tragopans (*Tragopan blythii*) and 4 Satyr tragopans (*T. satyra*), from France; and 2 Koklass pheasants (*Pucrasia macrolopha*) and 5 cheer pheasants (*Catreus wallichii*), from India.

The Public Health Service recently materially revised the regulations affecting the importation of birds of the parrot family. A privately owned shipment is now limited to three instead of five parrots, and it must be accompanied by the owner, who is required to certify that the birds have been in his possession for not less than 2 years and that he has no intention of selling, bartering, giving away, or publicly exhibiting them. Commercial shipments of parrots, or shipments of parrots for exhibition in zoological gardens or parks or for scientific study, now require, in addition to a permit from the Secretary, one from the Surgeon General. The period of quarantine, heretofore 15 days, has been extended to 6 months.

Among the more interesting parrots imported were 25 of 10 species as follows: 2 Ceram lories (*Trichoglossus haematod* or *Lorius flavopalliatus*), 1 Australian lorikeet (*Lathamus discolor*), and 2 Rajah cockatoos (*Probosciger aterrimus*), from Java; 1 bare-eyed cockatoo (*Ducorpsius sanguineus*), from the Philippines; 5 king parakeets (*Alisterus scapularis*), 4 pennant parakeets (*Platycercus elegans*), 5 Rosella parakeets (*P. eximius*), and 3 Brown's parakeets (*P. venustus*), from Australia; and 1 hawk parrot (*Deroptyus accipitrinus*) and 1 Finsch's parrot (*Amazona finschi*), from Central America.

Other interesting birds imported were 1 monkey-eating eagle (*Pithecophaga jefferyi*), from the Philippines; 1 yellow-striped spar-

row (*Atlapetes citrinellus*) and 20 rufous ovenbirds (*Furnarius rufus*), from Argentina; 4 Yuca birds (*Notiopsar curaeus*), from Peru; 2 Princess Stephanie birds of paradise (*Astrapia stephaniae*), 1 blue Prince Rudolph bird of paradise (*Paradisea rudolphi*), 1 Cape York riflebird (*Craspedophoro magnifica alberti*), and 3 six-plumed birds of paradise (*Parotia sefilata*), from New Guinea; 3 concave-crested hornbills (*Rhytidoceros plicatus*), from Singapore; 3 tigrine doves (*Spilopelia tigrina*), 3 Javan jungle fowl (*Gallus gallus bankiva*), 1 Javan owl (*Huhua orientalis sumatrana*), and 2 Javan coucals (*Centropus bengalensis javanicus*), from Java and Sumatra: 2 black-throated coachwhip birds (*Psophodes nigrogularis*), 1 spotted bower bird (*Chlamydera maculata*), 4 rifle birds (*Ptiloris victoriae*), 1 kagu (*Rhinochetus jubatus*), and 1 laughing jackass, or brown kingfisher (*Dacelo gigas*), from Australia; 2 Chinese mynas (*Sturnia turdiformis*) and 1 black-throated jay (*Garrulus lanceolatus*), from India; 3 Brewster's boobies (*Sula leucogastra brewsteri*), from Central America; 3 black-faced cardinals (*Paroaria nigrigenis*), from the West Indies; 1 restless flycatcher (*Seisura inquieta*), 2 bower birds (*Ailuroedus melanoti*), 1 giant heron (*Ardea goliath*), 2 sikkim red-headed laughing thrushes (*Trochalopteron erythrocephalum nigrimentum*), and 2 Argentine pygmy rails (*Laterallus leucopyrrhus*), in shipments from Germany.

A rather definite but as yet restricted trend toward the practice of falconry in a few sections of the country was indicated in some degree by the importation of gyrfalcons from Greenland and goshawks from Canada.

MAMMALS

Importations of black bear cubs from Canada were greater than for several years. The total number brought in was 137, compared with 87 last year. Importations of primates included 2 rare tarsiers (*Tarsius spectrum*), from the Philippines; several species of anthropoid apes and larger monkeys, from Africa; gibbons, macaques, and orangutans, from Singapore; and as usual a great variety of the smaller monkeys, including marmosets, capuchins, and spider monkeys, from Central America and South America. The total number of rhesus monkeys imported was 12,536, as compared with 15,851 last year.

Among the more interesting mammals imported were 14 of 10 species as follows: 1 pangolin (*Paramanis javanica*), from Sumatra, said to be the first of these animals ever brought alive to the United States; 1 "tiglon" (*Felis*), the offspring of a Siberian tiger and African lioness, in a shipment from Germany for the Central Park Zoo in New York City; 1 giant flying squirrel (*Eupetaurus cinereus*), also in a shipment from Germany; 1 cuscus (*Phalanger* sp.), from New Guinea; 1 giant panda (*Ailuropoda melanoleucus*), from China; 1 eyra (*Felis yagouaroundi*), and 1 Paraguayan opossum (*Didelphis paraguayensis*), from Brazil; 2 viscachas (*Lagostomus trichodactylus*), and 3 South American foxes (*Dusicyon* sp.), from Argentina; and 2 Tasmanian devils (*Sarcophilus harrisii*), in a shipment from the Netherlands.

PERMITS UNDER THE MIGRATORY BIRD TREATY ACT

FOR SCIENTIFIC PURPOSES

To take migratory birds or their eggs for scientific purposes, 341 permits (general or under specific limitations) were issued, 83 were revoked, and 1,715 were outstanding at the close of the year. To possess migratory birds or their eggs, lawfully acquired for scientific purposes, 70 permits (under limitations) were issued and 472 were outstanding at the close of the year. For possession of 1 or a few specimens of birds found dead, where the finder was not directly or indirectly implicated in the killing, 198 permits were issued. For banding migratory birds, permits were issued to 167 cooperators of the Bureau. For taking birds and mammals in Alaska for scientific purposes, 32 permits were issued, principally to scientific and educational institutions.

FOR PROPAGATION

Permits to take migratory waterfowl for propagation were issued to 44 persons, the permits prescribing the species and the number of individuals of each and the time during which they might be taken. To possess migratory waterfowl, lawfully acquired, for propagating purposes, 340 permits were issued. Because of failure of permittees to render the annual reports required by the regulations or to surrender permits when operations thereunder had been discontinued, 640 propagating permits were recalled, cancelled, or revoked. At the close of the year, 3,500 propagating permits were outstanding.

Reports submitted by permittees disclose that 3,493 wild geese and 62,218 wild ducks were reared in captivity, of which 56,352 were mallards, 3,509 black ducks, 863 wood ducks, and the remainder principally teals, ringnecks, wigeons, pintails, and redheads. Sales of propagated migratory waterfowl for food purposes included 13,073 ducks and 502 geese, and for propagation, 5,292 ducks and 1,053 geese. From propagated stock, 6 swans, 107 mourning doves, and 23 band-tailed pigeons also were produced. Of propagated birds, 20,613 ducks and 194 geese were liberated.

FOR DEPREDATION CONTROL

To enable permittees to protect crops, fishes, and other property from serious depredations by migratory birds, 407 permits were issued (by the Washington office of the Bureau, in a few instances, and by its regional directors). Many complaints of depredations were investigated by field agents of the Bureau and suggestions and aid given for relief without the necessity of killing the birds. In some instances where complaints were found to be without substantial foundation, permits were refused.

COOPERATIVE PREDATOR AND RODENT CONTROL

Cooperative predator and rodent-control operations during the year entailed expenditures of $644,774 from regular departmental appropriations, supplemented by $424,973 from cooperating States, $967,993 from cooperating counties, livestock associations, and others, and about $735,199 from emergency funds for control work con-

ducted under Bureau supervision. Predatory animals taken in this cooperative program numbered 104,076, exceeding last year's record by 10,036, and consisted of 93,093 coyotes, 1,214 wolves, 9,033 bobcats and lynxes, 495 bears, and 241 mountain lions. In rodent-control operations 35,465,078 acres were treated for reducing infestations of prairie dogs, ground squirrels, pocket gophers, jack rabbits, field mice, cotton rats, kangaroo rats, porcupines, and woodchucks. In addition, 212,591 premises were treated in cooperative campaigns for the elimination of common brown rats. A worth-while supplement to regular predator-control operations was made possible in Utah, Idaho, Wyoming, Montana, and Oregon through W. P. A. cooperation Hunters were employed by that Administration to work, under Bureau supervision, on programs furthering protection to range livestock.

CONTROL OF PREDATORY ANIMALS

During the year coyotes held first place among predators of economic importance. In the range States they contributed heavily to livestock, poultry, and game losses, and in many sections they were more numerous than for many years and because of this increased their depredations. A survey made in Alaska revealed that coyotes and wolves are increasing there and that their depredations on reindeer herds are becoming more serious. Additional evidence that the coyote is making its appearance in the East was noted: during the fall of 1938 individuals were taken in Pennsylvania and in Maine, the first recorded cases of their presence in these States, and the species was found in new localities in Michigan. A contributing factor to the upward trend in coyote population has been the decreased activity of private trappers who formerly captured carnivorous animals for the cash value of the pelts. This situation is accounted for through the depressed market for the pelts, owing to general economic conditions and shifting demands in fur and fur products.

Appreciating the seriousness of the predator situation, New Mexico, Arizona, Oregon, Utah, and Montana, through their respective State legislatures, increased their cooperative funds for control work directed by the Bureau and other States maintained their contributions. State fish and game departments, livestock associations, and other agencies and individuals raised additional funds to expand cooperative control operations. In Missouri, where wolves and bobcats inflicted heavy losses in game refuges and parks, the State Conservation Council requested aid in alleviating the situation.

TYPICAL EXAMPLES OF PREDATION

Following are a few specific examples of recent losses caused by predatory wild animals:

Coyotes.—In the Western States coyotes are a constant menace to the sheep and poultry industries, and their depredations have been more widespread and in the aggregate more severe than those of all other predators. On a ranch in Montrose County, Colo., 40 lambs were killed in 2 weeks by a single two-footed coyote; on a ranch in northwestern Colorado 60 sheep were killed within 20 days; a hunter personally observed the killing of 6 deer and 23 sage chickens in Jackson County, Colo.; in Natrona County, Wyo., a sheepman esti-

mated his loss at $1,000 per band per year; an incorporated ranch in South Dakota offered a $500 reward for the capture of a single destructive coyote; on a ranch at Casa Grande, Ariz., 40 turkeys were killed in 1 night; early in 1939 a rancher near Wilcox, Ariz., lost 32 registered calves; an Arizona rancher lost 15 percent of his sheep while making a drive of 25 miles; a ranching company of Battle Mountain, Nev., reported the loss of 25 to 35 percent of the lamb crop in a band of 5,000 sheep.

Wolves.—In Atascosa County, Tex., wolves killed 20 goats on 1 ranch and 100 turkeys on another in a period of 20 days; the Catahoula Division of the Kisatchie National Forest, La., reported 50 cattle, 60 goats, and 150 hogs destroyed during the year; 8 wolves killed more than 50 cattle in Santa Cruz and Pima Counties, Ariz.; a single raid by wolves in another area of Santa Cruz County resulted in the death of 18 cattle and serious injury of 14 others.

Other predators.—A mountain lion killed 22 sheep in 1 night in western Juab County, Utah; so many colts were killed by mountain lions on the San Carlos Indian Reservation, Ariz., that the project for the improvement of Indian horses through the purchase of valuable brood mares and stallions was defeated; herders on the Battle Mountain division of the Medicine Bow National Forest, Wyo., reported 30 lambs on 1 bed ground killed by bears in 1 night; reports from 200 representatives of the Idaho Woolgrowers' Association revealed a yearly loss of 100,000 lambs and 40,000 ewes through predatory-animal depredations.

SOME RESULTS OF PREDATOR CONTROL

In 1930 coyotes were reported in Pearl River County, Miss., and by 1938 the sheep raisers had suffered such reductions in their flocks that the industry was no longer profitable. A Bureau hunter brought the situation under control, and the sheep industry of that county is now making definite strides toward recovery. Previous to 1938 a poultryman in Bee County, Tex., lost 46 of his 48 turkeys and 220 of his 230 chickens to coyotes. After a Bureau hunter took 476 predatory animals in the area the farmer again undertook poultry raising, beginning with 2 turkeys and a few chickens, and from this small stock has developed flocks without loss. In Washington, coyote control has resulted in a very noticeable increase in the number of game birds in the sagebrush areas, and in the pot-hole district of the State the ducks are no longer molested by predators.

In Stephens County, Tex., after 75 days of persistent effort, a Bureau hunter captured a crippled wolf that had killed $1,000 worth of sheep and goats on 1 ranch. When caught the animal had 1 forefoot missing, 2 toes off 1 hind foot, and the other hind foot broken. After Bureau hunters working in Hidalgo County, N. Mex., curtailed wolf migrations from Mexico, livestock losses in the vicinity were reduced. In the Santa Rita Mountains, near Patagonia, Ariz., a Bureau hunter captured a pair of wolves that had just previously killed a mature cow, 7 yearling cattle, 10 calves, and 4 deer.

In Hudspeth County, Tex., a marked increase of black-tailed deer was recorded, owing to previous mountain lion control. In Montrose County, Colo., a bear was taken that had killed 15 cattle in the preceding 2 months.

CONTROL OF INJURIOUS RODENTS

Field rodents, including ground squirrels, prairie dogs, kangaroo rats, and pocket gophers, continued to be the cause of serious losses in horticultural and other crops, range vegetation, and silvicultural plantings in the West, while tree-girdling mice raised havoc in rural sections of the East. Rats inflicted their usual heavy losses to growing crops and stored food supplies throughout the country, and damage by pocket gopher burrowings to mechanical soil-and-water-conserving structures continued.

Though damage in the aggregate was heavy, yet effective and persistent control measures conducted by various agencies cooperatively with the Bureau aided materially in reducing losses and preventing rodent depredations on many areas. Realizing the importance of rodent control in the conservation of range forage and water resources, users of winter ranges, through advisory boards of the Division of Grazing of the Department of the Interior, cooperated to a substantial degree in conducting rodent control on grazing areas. Cooperative rodent-control work also was conducted through the medium of C. C. C. camps operating under the jurisdiction of the Forest Service and the Soil Conservation Service of the Department of Agriculture and of the Division of Grazing, Bureau of Reclamation, and Office of Indian Affairs of the Department of the Interior. In addition, a number of effective W. P. A. projects were conducted. The work was supervised by trained personnel of the Survey and was undertaken only on areas where it would contribute to range rehabilitation, protection of irrigation and soil-conserving structures, silvicultural plantings, and farm crops.

RODENTS IN RELATION TO THE SPREAD OF DISEASE

Control work was stressed in areas of sylvatic plague prevalence to aid in stamping out the infection and curtailing its spread. On August 20, 1938, the Public Health Service reported plague infection in prairie dogs and field mice in Catron County, N. Mex., and on May 19 in kangaroo rats in Nona Ana County, N. Mex. During the year plague was found also among prairie dogs in Apache County, Ariz. These are believed to be the first positive findings of the disease in these States. Plague was also discovered among ground squirrels (*Citellus armatus*) in a new area in Utah, Rich County.

INSTANCES OF RODENT DAMAGE

Following are a few specific examples of recent damage by the principal species of rodents requiring extensive control:

Pocket gophers.—In Hopkins County, Tex., a farmer lost 10 percent of his 7,000-bushel sweetpotato crop through pocket gopher scars; 3 soil-conserving structures on a farm near Choudrant, La., were severely damaged by washing, because of runways; tunneling through extensive terrace structures, designed to lessen soil erosion and prevent floods on the Wasatch Forest, Utah, became so serious as to defeat the purpose of the terracing; in Titus and Morris Counties, Tex., burrows so undermined the highways that the pavement settled and broke and runways caused erosion in the dirt shoulders.

Ground squirrels.—In Moffat County, Colo., the depredations of ground squirrels were so severe that removal of these rodents must precede any land-use program for the area.

Meadow mice.—The hurricane and floods of September aggravated the damage inflicted by meadow mice to fruit trees in Rhode Island and Connecticut by uprooting the trees, thus exposing the roots and crowns to field mice and furnishing channels to the lower roots, where severe girdling resulted. In 1 orchard 85 of 105 trees were thus damaged. Floods also forced the mice from the lowlands into the orchards. Damage was especially severe in parts of the Northeastern States where no control work had been done by the Bureau in the previous year. One orchardist near Sodus, N. Y., lost 2,500 apple trees through tree-girdling mice. In Delaware 50 peach trees in 1 orchard were severely damaged by pine mice.

Rats.—The ever-normal-granary program of the Department in some States was interfered with by rats. Farmers along bottom lands of the Ohio River and its tributaries were forced to replant their crops, some as many as three times; one poultry plant in Massachusetts reported the annual loss caused by rats as $12,000; near Randall, Tex., a poultry farmer sustained a $75 loss of baby chicks; on a poultry farm in Leicester, Mass., 600 baby chicks were killed by rats in 1 night; and at Lubbock, Tex., a packing plant suffered a $500 loss to its storage stocks.

SOME BENEFITS OF RODENT CONTROL

Organized control of ground squirrels conducted during the past 2 years in Grand County, Colo., has resulted in nearly complete suppression of these rodents. Range grasses have shown a remarkable recovery, and severe ground squirrel depredations to head lettuce, an important cash crop of the area, have been eliminated.

Organized country-wide prairie dog control in Delta and Montrose Counties, Colo., during the last 4 years has made it possible for crops again to grow on many areas, whereas previous rodent infestation had been so severe that on many fertile tracts agriculture had been abandoned. In Moreno Valley in northern New Mexico, prairie dog control on heavily infested lands, conducted during the spring of 1939, allowed farmers to raise crops of potatoes, peas, beans, and oats. After 3 years of prairie dog control on a 40-section ranch in Texas, where 99 percent of the rodents were eliminated, the range so far recovered as to carry 1,000 more cattle and 4,000 more sheep than previously.

Pocket gopher-control operations on plantations of the Kisatchie National Forest, La., reduced damage to seedling trees to practically nothing.

In March the Galveston (Tex.) Wharf Co. reported only 6 sacks of flour cut into by rats on its wharves, this being the first damage of the kind reported in the approximately 18 months since cooperative rat-control has been underway. Before control measures were instituted it was not uncommon to have as many as 25,000 sacks cut into every month and flour shipping and storage on several piers had had to be abandoned. Cooperative rat control at Port Gibson, Miss., was so effective that in a single grocery store only an occasional sign of rat damage was noticeable, whereas the annual loss to the store through rat damage previously had been estimated at $300.

In certain orchards of the Northeastern States, where control of meadow mice had been practiced the previous year, damage was reduced to a negligible figure, whereas in untreated areas losses were extremely heavy.

A nurseryman of Stephensville, Tex., reported a $1,000 loss to nursery stock by rabbits before control measures terminated the depredations.

Repellent sprays against rabbits, applied to 4,000,000 slash pine seedlings in the Stuart Nursery of the Kisatchie National Forest, La., resulted in substantially reduced damage, increased sprouting, and greater survival of seedlings.

SUPPLY DEPOT AND LABORATORY

An addition to the supply depot and laboratory at Pocatello, Idaho, was practically completed by the Bureau in cooperation with the W. P. A. and the Pocatello Chamber of Commerce. The plant now provides additional laboratory facilities for scientifically compounding baits and for testing various baits and their toxic ingredients, space for storing rodent-bait materials and field supplies, and facilities for preparing special field equipment and pyrotechnic cartridges for use in rodent control. In cooperation with the Pocatello Chamber of Commerce, the supply depot prepared and distributed to cooperators in the United States 1,774,882 pounds of rodent-bait materials, as well as special bags, predatory-animal traps, and rodent-control equipment.

RESEARCH IN CONTROL METHODS

The Control Methods Research Laboratory, at Denver, Colo., made progress in developing and perfecting methods for the control of field rodents, including repellent sprays for the protection of seedling trees in silvicultural plantations. Ecological studies of rodents and predatory animals were continued looking toward the development of improved control methods; experiments were undertaken for the improvement of traps and trapping technique, as well as other methods of taking predatory animals; and predatory-animal baits for use in cooperative control work were processed and prepared.

RODENT CONTROL AND FOREST REGENERATION

Because of heavy pocket gopher, mouse, and rabbit damage, it is impossible on many cut-over and planted areas to get stands of natural reproduction or planted seedlings. In the words of an official of the Southwest Range and Forest Experiment Station: "One might almost say that given average precipitation and a good seed supply, seedlings will become established wherever rodents are excluded, but in no place where they are present." Research has been conducted on the protection of seeds in spot plantings until they can germinate and grow beyond danger of destruction by small rodents. An effective rodent bait was developed that can be used in more extensive silvicultural plantations and natural reproduction areas, and a method of exposure devised that will afford protection to other forms of wildlife. Repellent sprays were developed, and when applied to nursery seedlings, reduced the damage by cottontail rabbits from 40

to 3 percent. Studies are under way for the development of a spray that will be effective in repelling other species of rabbits from seedling stock.

STUDIES OF MEADOW AND PINE MICE

Methods of controlling meadow and pine mice in the Northeastern States have been improved as to time of year and method of application of baits, as a result of more detailed studies of the life habits of these rodents. A motion picture was made to demonstrate to orchardists the natural habits of these mice, the type of damage done, and methods of effective control.

TOXICITY AND FUMIGANT INVESTIGATIONS

Toxicity studies of red squill, an important ingredient of rat baits, progressed, and a standard method of bioassaying the product was further developed. In a cooperative undertaking by the Bureau of Biological Survey, the Bureau of Plant Industry, and the American University of Beirut, a research study was inaugurated at Beirut, Lebanon, Syria, for determining the relationships of toxicity of squill bulbs to growing and cultural conditions. Cooperative studies also continued along the line of extracting the toxic principle of red squill.

Improvement was made in the development of poison-gas pyrotechnic cartridges that can be used readily and safely in the control of burrowing rodents. Studies were also made for perfecting other fumigants and methods of applying them.

WILDLIFE CONSERVATION IN ALASKA

CHANGES IN REGULATIONS

The Secretary's regulations for 1939–40 relating to game, land fur animals, and birds in Alaska were published in Alaska Game Commission Circular No. 17 in June. They provide for a free certificate for native Indians or Eskimos of one-half or more Indian or Eskimo blood, in lieu of the $2 resident hunting and trapping license formerly required. To safeguard further the livelihood of the natives and to conserve the fur animals of the Territory, the regulations require that applicants for resident-trapping licenses must have resided in Alaska continuously for 3 years to be eligible therefor. Since black bears, including the brown and blue color variations, are now being sought as trophies of the hunt rather than for their pelt value, the regulations transferred them from the status of fur animals to that of game. An open season is provided for all fur animals except beavers in fur district 1, which was closed to trapping during the season 1938–39, and an open season on beavers is provided during the spring of 1940 in fur districts 2, 4, and 5. Seasons on martens were also fixed throughout the Territory.

LAW ENFORCEMENT

Two patrols of outstanding importance in the enforcement of the Alaska Game Law should be mentioned. In the remote headwaters of the Kuskokwim River, an Alaska wildlife agent and his deputy traveled more than 600 miles on snowshoes during the 6 weeks pre-

ceding the open trapping seasons, undergoing grueling hardships when forced to spend several nights in the open with temperatures ranging from −30° to −60° F. They succeeded in apprehending 5 poachers of long standing and seized the skins of 26 martens and 1 mink. In every case convictions were obtained and substantial fines and jail sentences were imposed. One violator demanded trial by a jury composed almost entirely of neighboring trappers, which to his surprise quickly brought in a verdict against him. The other 4 then pleaded guilty.

In a cooperative patrol with the mounted police of Canada, 2 other wildlife agents covered about 3,500 miles by air in a month and in addition traveled many miles on snowshoes and skis over trap lines along both sides of the Alaska-Yukon boundary. They uncovered evidence that residents of Alaska and Canada were promiscuously trapping in the territory across the boundary. They found and broke up a ring well organized for smuggling wolf and coyote pelts and leg bones into Alaska from Canada for collecting the $20 Territorial bounty. In 1 instance, 84 leg bones of wolves and coyotes were seized from a Canadian mail carrier enroute to a trading post in Alaska, and at Dawson he was found guilty on 4 separate counts, involving illegal trading and the possession and use of poison. They apprehended 8 violators and seized large quantities of furs, which were forfeited to the respective Governments. In the possession of 1 trader were found 7 quarters of mountain sheep meat, for which he was receiving 30 cents a pound. The agents also halted considerable traffic in other kinds of game animals. The air patrol was made extremely hazardous by adverse winter weather and lack of landing fields, which necessitated landing on and taking off from frozen rivers, lakes, and open stretches, but it resulted in a better understanding with Canadian authorities and will have the effect of discouraging indiscriminate violations long associated with the wilderness section through which the boundary line runs.

One wildlife agent of the Alaska Game Commission flew his own airplane extensively along the bleak Arctic coast, low enough to inspect trap lines and spot evidences of violations. On patrols ranging from Prince William Sound to the Arctic Ocean, he covered approximately 12,000 miles, several times furnishing air transportation to agents in whose districts he was flying. The excellent results obtained by this agent, noted in better observance of the game laws, strongly indicate the need of Government-owned and operated airplanes for work in enforcing game and fur laws in Alaska, as under present-day conditions flying is the only effective method of patrolling the vast hunting and trapping areas in the Territory.

In all, 252 violations were reported, as compared with 346 during the previous year. These included 33 involving illegal acts by aliens. Fines in the amount of $8,705 were imposed, in addition to jail sentences aggregating 3,614 days. The 700 furs seized included 399 beaver, 68 marten, 58 mink, 48 muskrat, 45 weasel, 24 red fox, 20 land otter, 15 white fox, 11 lynx, 5 cross fox, 2 polar bear, 2 wolverine, 2 black bear, and 1 wolf. A total of 25 game animals and 7 game birds illegally taken—namely, 11 deer, 5 caribou, 5 moose, 3 brown and grizzly bears, 1 goat, 6 ducks and 1 swan—and 60 firearms, 66

traps, and 16 snares were seized. The estimated value of the confiscated furs, guns, and traps was $8,632.

WILDLIFE-RESTOCKING PROJECTS

Through the courtesy of the Washington State Game Department, 864 eggs of Mongolian pheasants and 30 of chukar partridges were received at the Territorial experiment stations at Petersburg and Matanuska, and from those hatched it is hoped to develop adequate breeding stock. Wild wolverines and timber wolves were sent from Alaska to the Wisconsin Conservation Department in exchange for game birds of hardy varieties, including the brown, blue-eared, and cheer pheasants. Population increases demonstrate a growing need for game birds of this type in Alaska, for although the Territory has an abundance of native ptarmigans and grouse, epizootics sweep them away at intervals.

The plantings of beavers, snowshoe hares, and muskrats on Kodiak Island a few years ago have resulted in gratifying increases, and the 8 elk placed on Afognak Island in 1927 have multiplied to a herd of well over 100. The 19 buffaloes transplanted from Montana to the Big Delta region near Fairbanks in 1928 have now increased to a herd of approximately 150, including 1 albino calf. The flock of 18 mountain goats transplanted in 1923 from the mainland near Juneau to Baranof Island near Sitka is also reported to have passed the 100 mark. The initial stock of 34 musk oxen, received at Fairbanks from Greenland in 1929 and transferred to Nunivak Island Wildlife Refuge, has multiplied to more than 60.

PREDATOR CONTROL

Predatory-animal control was continued in the Territory on a limited scale under Bureau supervision and in cooperation with the Reindeer Service of the Office of Indian Affairs and the Alaska Game Commission. The Bureau's participation was limited to instructions to private trappers, distribution of scent materials and trapping equipment, and a general study of the problem. At its last biennial session the Territorial Legislature amended the law providing a $20 bounty on wolves and coyotes so as to require certification of all bounty claims by wildlife agents of the Commission. Carrying out the provisions of the amended law is expected to develop much information regarding these predators that will have a valuable bearing on future control measures. Following a complaint from Kodiak Island that certain brown bears were killing cattle, two observers, under the direction of a wildlife agent of the Commission, went to the island in March to make a study of the situation, remaining there through June.

RESEARCH ON ALASKAN WILDLIFE

Bureau studies are being made of the Kenai moose, the largest American hoofed animal, particularly of its abundance and relation to agricultural developments. An estimate in 1933 indicated 1,300 animals, but in the fall of 1938 investigation showed a reduction to 1,033. There seems to be a disproportionate number of bulls to cows

and a calf crop below normal. On Kodiak Island a preliminary study was made of wildlife problems, particularly of the relationships of the brown bear to cattle and of beaver operations to cattle range and fishing interests. A biologist spent 2 months in a reconnaissance of the Aleutian Islands, making representative collections of wildlife and investigations as to proper wildlife use of the various islands.

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